MINING CONGRESS JOURNAL

NOVEMBER 1960

Report on 1960 AMC MINING SHOW

This Red Rubber is a better rubber for runners pumping abrasive pulps because it has...

Higher tensile strength

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High resilience and Greater abrasion resistance

This permits handling coarser pulps at higher pumping speeds and heads...at lower costs!*

This abrasive resistant stock is standard on all runners for DENVER SRL and SRL "Tru-Glandless" Pumps (sizes to 10" x 8"). Other polymers are available for applications involving high temperatures, oils or acids where abrasion is a secondary problem.

These DENVER SRL Pump runners are especially suited for pumping grinding mill discharge to cyclone classifiers where coarse particles (up to ¾") normally would be a problem.

Tough, live DENVER SRL Red Rubber outwears, outlasts, outperforms generally-used gum rubber and allows DENVER SRL Rubber Lined Pumps to be used where metal pumps have been considered necessary.

**We are interested in cutting your pumping costs—and we have the pumps to do it! Give us a chance at your toughest pumping job.*

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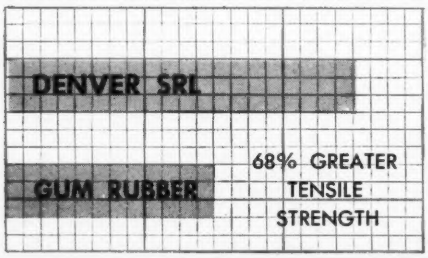

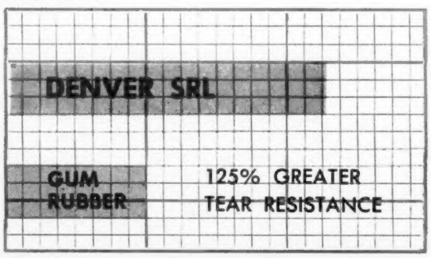

= MORE WEARING LIFE / MORE $$'s SAVED

MINING CONGRESS JOURNAL

VOL. 46 NOVEMBER 1960 NO. 11

Indexed regularly by Engineering Index, Inc.

CONTENTS

Opinions expressed by the authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

ARTICLES

SPECIAL SECTIONS

DEPARTMENTS

ON OUR COVER

Highlights of 1960 AMC Mining Show — (upper left) Convention-goers view operations at Blue Diamond Company's gypsum mine during one of two outstanding trips following the meeting — (lower left) A "packed house" listened intently while Senator Barry Goldwater addressed the session on Labor Relations — (right) Two hundred and twenty-five exhibitors displayed their latest equipment to thousands of mining men.

Published Monthly. Yearly subscriptions, United States, Canada, Central and South America, $3.00. Foreign, $10.00. Single copies, $0.75. February Annual Review Issue, $1.25. Second class postage paid at Washington, D. C., and at additional Post Office, Lancaster, Pennsylvania.

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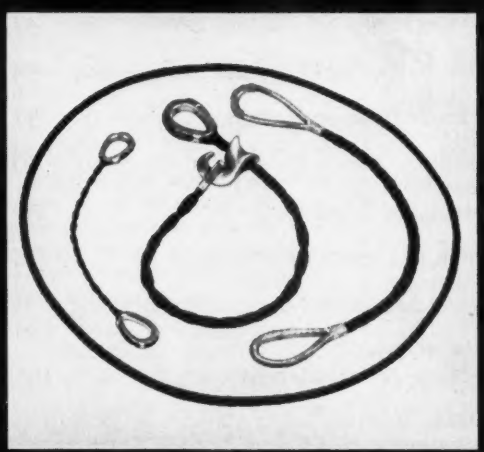

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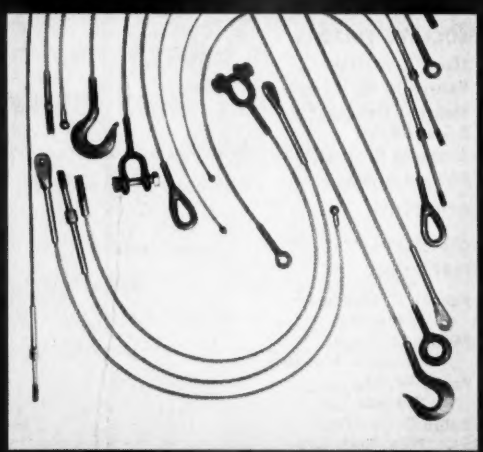

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Macwhyte Wire Ropes are made complete by Macwhyte from domestic steels, drawn and fabricated in Macwhyte's own wire and rope mills.

featured

IN THIS ISSUE—and the AUTHORS—

PART I — THE DESIGN OF AMMONIUM NITRATE-FUEL BLASTING AGENTS

The effective use of ammonium nitrate as a blasting agent depends upon the incorporation of a large number of proper design factors. Particle size, loading density, admixed oxidizing agent, particle density, confinement and resulting sensitivity are some of the parameters upon which the correct use of available chemical energy depends. Many of these have been evaluated by laboratory and field research, while others remain to be investigated. As a direct result of these studies, a number of inexpensive blasting agents have been devised and are finding wide applications.

MECHANIZED RAISING AT THE IRON KING MINE

A new way of driving raises at the Iron King Branch of Shattuck Denn Mining Corp. involves the use of a machine known as the Alimak raise climber. The climber is propelled to any desired height in the raise by an air motor that drives pinions meshing into a guide rail rack bolted to the raise wall. Raising by the new method is faster than the previous method, and significant savings in timber and labor costs have been realized.

SOME ECONOMIC ASPECTS OF COAL PREPARATION

A preparation program to justify its cost must permit increased realization, retention or expansion of markets, or decreased mining costs. Benefits to be derived from ash and sulphur reduction, losses due to throwing away refuse and slurries, and other factors must be evaluated in their proper relationship to insure a selected combination of coarse and fine coal preparation processes that will give over-all maximum economic benefit to the producer.

OPEN PIT OPERATIONS IN THE GAS HILLS OF WYOMING

Uranium was discovered in the Gas Hills in 1953 and the area has since become one of the leading producing districts in the nation. Surface and near surface deposits were the first to be exploited, but now some open pit operations extend to depths of over 300 ft. In 1959, 25,000,000 cu yd of waste were stripped, up from 4,700,000 in 1957 and only 200,000 five years ago.

(CONTINUED ON PAGE 5)

Dr. George B. Clark, with the assistance of Robert J. Bruzewski and Dr. Joseph J. Yancik, has presented a keen analysis of ammonium nitrate-fuel blasting agents. Dr. Clark is professor of mining engineering and Bruzewski is associate professor of mining engineering at the Department of Mining Engineering, Missouri School of Mines. Dr. Yancik is research engineer for Monsanto Chemical Co. Prior to joining the University of Missouri in 1954, Dr. Clark had served in various positions at the University of Illinois, U. S. Bureau of Mines, University of Utah, and Tintic Standard Mining Co. of Utah.

B. R. Waples, Jr., has been associated with the Iron King Branch of Shattuck Denn Mining Corp. since 1953, where he is presently chief engineer. Earlier, he was mine engineer and then design engineer. From 1947 to 1953, he was with the Fluorspar Division of Aluminum Co. of America. Positions with Alcoa included junior engineer, staff engineer, assistant general mine foreman and general foreman of outlying property.

Frank R. Zachar's early engineering and operating experience was with Pittsburgh Coal Co., Koppers Coal Co., Duquesne Light Co. and Hanna Coal Co. From 1948 to 1955 he was general superintendent of Christopher Coal Co., a subsidiary of Consolidation Coal Co. He left that position to do consulting work in connection with Consolidation's expansion program in northern West Virginia. Late in 1957 he formed his own organization and has since been offering consulting services to the industry.

Roy Coulson is Wyoming Division superintendent for Vitro Minerals Corp., a subsidiary of Rochester & Pittsburgh Coal Co. and Vitro Corp. of America. He has held this position since 1955, prior to which he was employed by Rochester & Pittsburgh in various positions throughout the company for eight years.

(CONTINUED FROM PAGE 3)

IN THIS ISSUE—and the AUTHORS—

MAINTENANCE OF TRACK HAULAGE SYSTEMS

The chief engineer of a progressive mining company in Pennsylvania has taken a keen look at rail haulage from a maintenance viewpoint, paying particular attention to such components as rail, trolley wire, feeder lines, switches, signals and rolling stock. Because one of the greatest problems facing management is that of good housekeeping on underground haulage roads, he also describes the advantages of mechanical cleaning and emphasizes the importance of adhering to a rigid track cleaning schedule. The theme of this article is that the important thing is not a matter of how much an installation costs, but the rapidity with which that investment can be amortized in the maintenance of the system.

THE EL SALVADOR MILL

Andes Copper Mining Co. is currently treating 20,000 tpd of ore in a modern four-section concentrator that went on stream in May 1959. The metallurgical process, from the crushing plant through the mill to the tailings thickener and molybdenum plant, is thoroughly described and some interesting plant features are discussed. The author also tells how good control of the flotation circuit is achieved and its significance at El Salvador.

PERSONNEL EVALUATION AND SELECTION

In view of the competition in securing and retaining qualified personnel, the management of the North American Coal Corp. realized several years ago the need for a method of evaluating present employes and some sort of "yardstick" to assist in the selection of potential employes for its organization. Accordingly, through the assistance of a psychological testing firm, a program tailored to the needs of North American's operation was set up. The type and scope of the program is fully described, and results assessed.

OPERATIONS RESEARCH IN LIMESTONE MINING

Problem: How to economically and efficiently mine 430,000 tons of limestone a year from a six-ft seam overlain by up to 130 ft of overburden? Many said it could not be done, but Marquette Cement launched a research study which led to a conclusion that it could. This informative report covers in detail the approach to the problem, the actual investigation, and the recommendations arrived at through operations research.

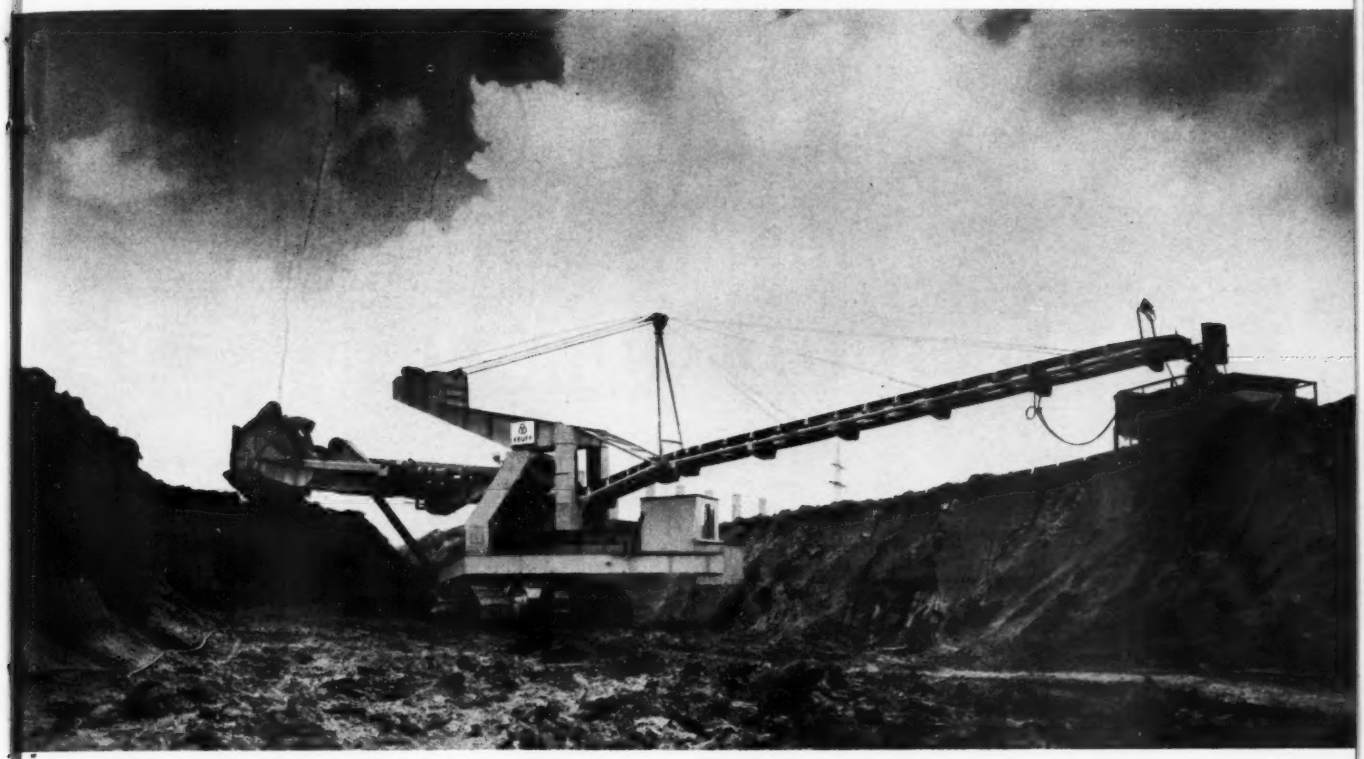
J. S. Schrecengost has been chief engineer of Allegheny River Mining Co. since 1946 and is on its board of directors. Previous experience includes serving as field engineer for Herbert & Henderson Engineering Co. of Kittanning, Pa., and chief engineer for Freebrook Corp. and Widnoon Co., also of Kittanning.

Peter B. Hobsbawn has been superintendent-metallurgical operations at Andes Copper Mining Co. since 1958. He was previously general foreman at the Chuquicamata concentrator of Chile Exploration Co. From 1946 to 1950, at which time he joined Chile Exploration, he was a mining engineer with Lautaro Nitrate Co. A native of England, Hobsbawn has lived mostly in Chile.

C. G. Evans entered the coal industry in 1922 and, except for time out to attend the University of Cincinnati and Western Reserve University Graduate School for Industrial Psychology, he has been associated with the industry ever since. Prior to his present position of personnel manager of the North American Coal Corp., he served in such capacities as mining engineer, safety director, superintendent and general superintendent. He has a vast working knowledge of mines in North Dakota, Ohio, West Virginia, and Pennsylvania.

David G. Lewis is quarry superintendent at the Superior, Ohio, plant of Marquette Cement Manufacturing Co. where he has been employed since 1958. He was previously manager of a lightweight aggregate plant for Materials Service Co. From 1947 to 1957, Lewis was with Sunnyhill Coal Co., and was superintendent at New Lexington, Ohio, for six of these years.

KRUPP



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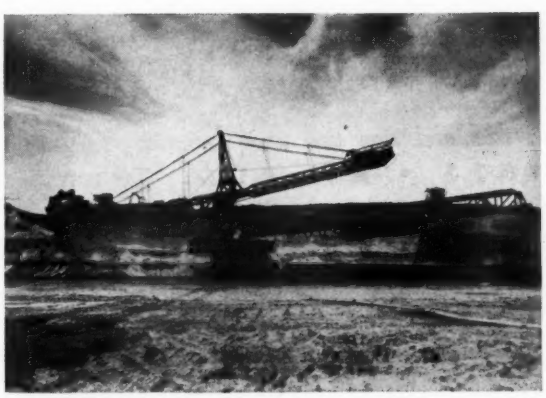

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Output:	up to 470 cu.yds/hr.
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Length of bucket wheel boom:	31 feet
Length of loading conveyor boom:	66 feet

This type of bucket wheel excavator was exhibited at the 1960 Mining Show of the American Mining Congress in Las Vegas, Nevada.

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Underground filmed report shows how one mine moves hard rock for less than 20¢ a ton . . .

You have probably heard of the Young Mine of American Zinc, Lead and Smelting Company and wanted to see their operation. It is believed to be one of the world's most economically-operated hard rock mines. Many have come to observe their methods, several from foreign countries. This mine operates two shifts. A total of only 95 hourly employees produce more than 3,000 tons daily. The low cost operation is the primary result of the tremendous tonnage moved by self-loading transports manufactured by Sanford-Day. Three of these S-D Transloaders, requiring only three men per shift, load, haul, and dump all the ore produced. Total cost is less than 20¢ a ton. This includes cost of original investment, maintenance and labor. Another feature of this mine that visitors observe and ask questions about with a great deal of interest is the haulage equipment. Only 28 S-D Automatic Bottom Dumping mine cars are necessary to haul the entire 3,000-ton daily production to tipple and it costs less than 4¢ a ton. We recently completed and have available now for your study a documentary 18-minute color-sound 16mm movie showing every phase of this low cost operation — from drilling to transportation of ore to mill. Ask us to mail this film to you for showing to your operating personnel . . . or, ask us to have one of our representatives bring projector and the movie to show for you. Write or call us today. Use coupon below to make mail request.

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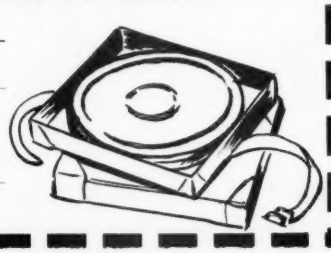
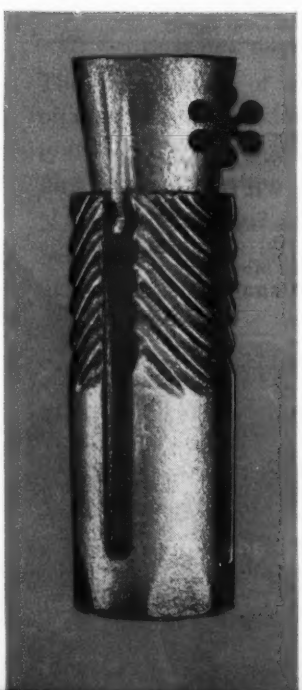


O-B Designs For Mining Men

A 4-way expansion unit that holds in soft shale or hard rock



4-WAY EXPANSION UNIT BUILDS HOLDING POWER FAST . . . because the flexible fingers of the shell are slightly pre-expanded to grip the wall even before wrenching begins.

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For freeze-proofing coal, get Standard's WR 663½ Oil.

Get all the facts about STANDARD Coal Spray Oils and freeze-proofing oil from the Standard Oil office nearest you anywhere in the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

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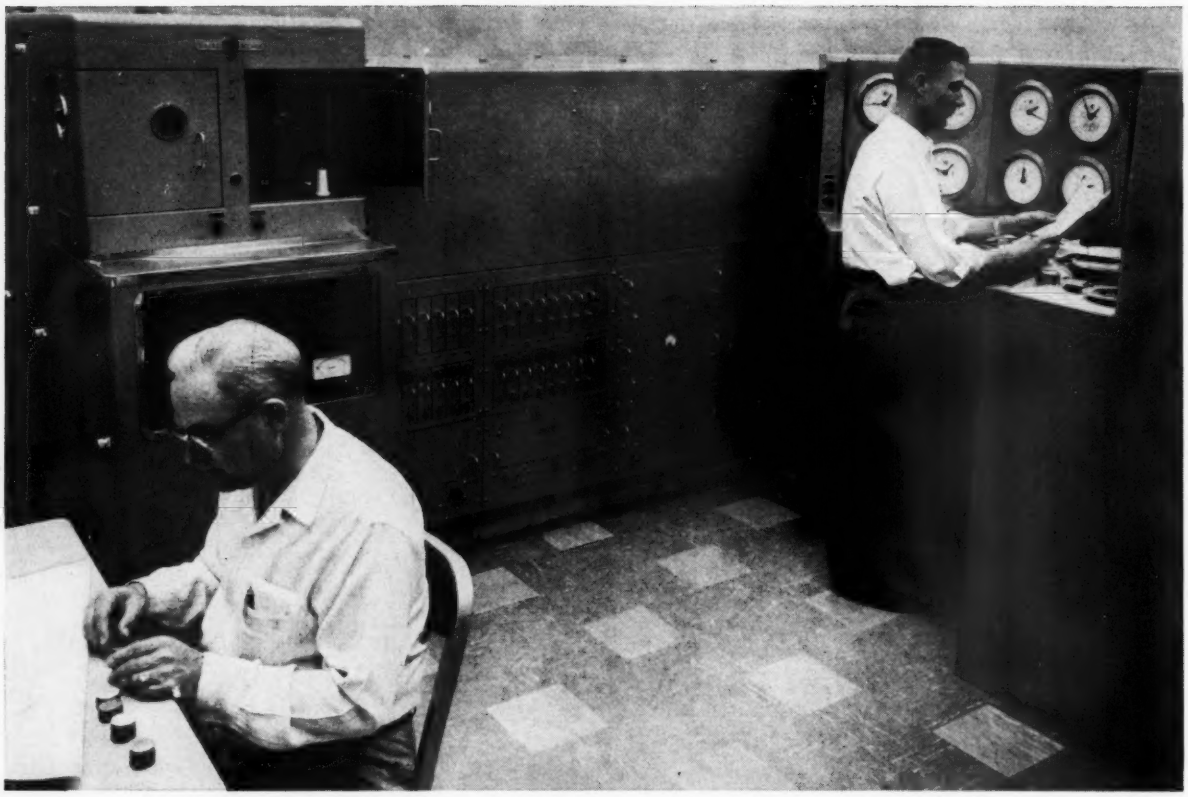

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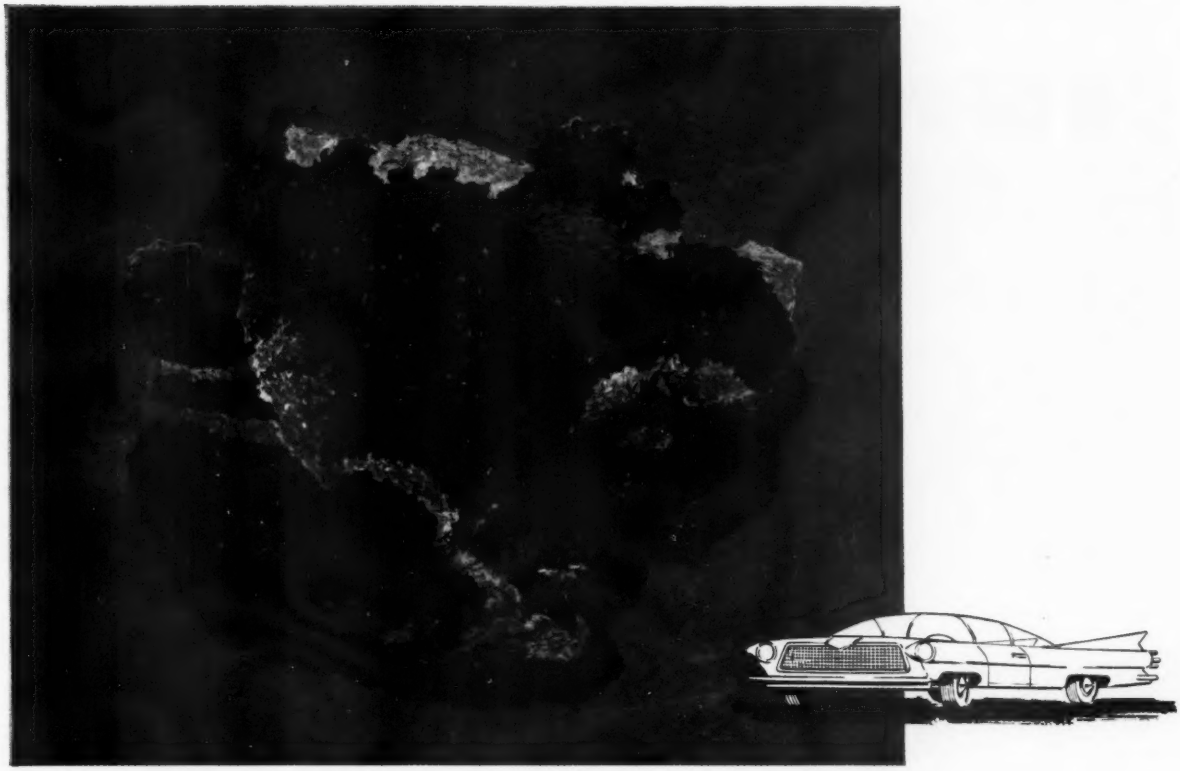

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Zinc, from the ore *sphalerite*, is a metal of great economic importance. In the automotive industry alone, the increasing decorative and functional use of zinc die castings for grilles, instrument cluster housings, dash panel bases, door handles, etc., demonstrate the ore's economic value. It has long been used for galvanizing, brass making, and zinc-white pigments.

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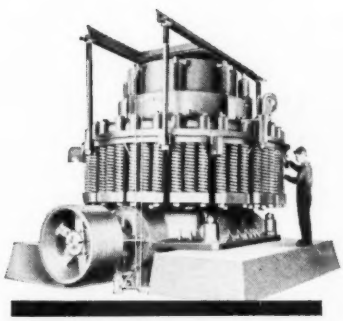

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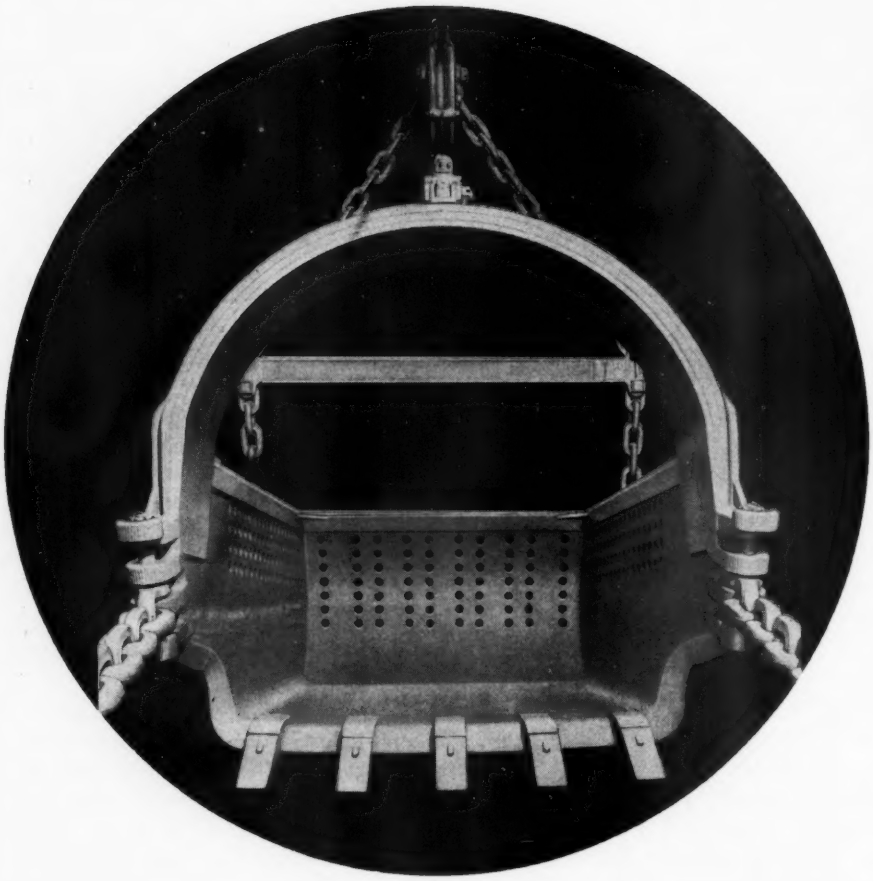
"H" HENDRIX

Heavy Duty Mining Buckets



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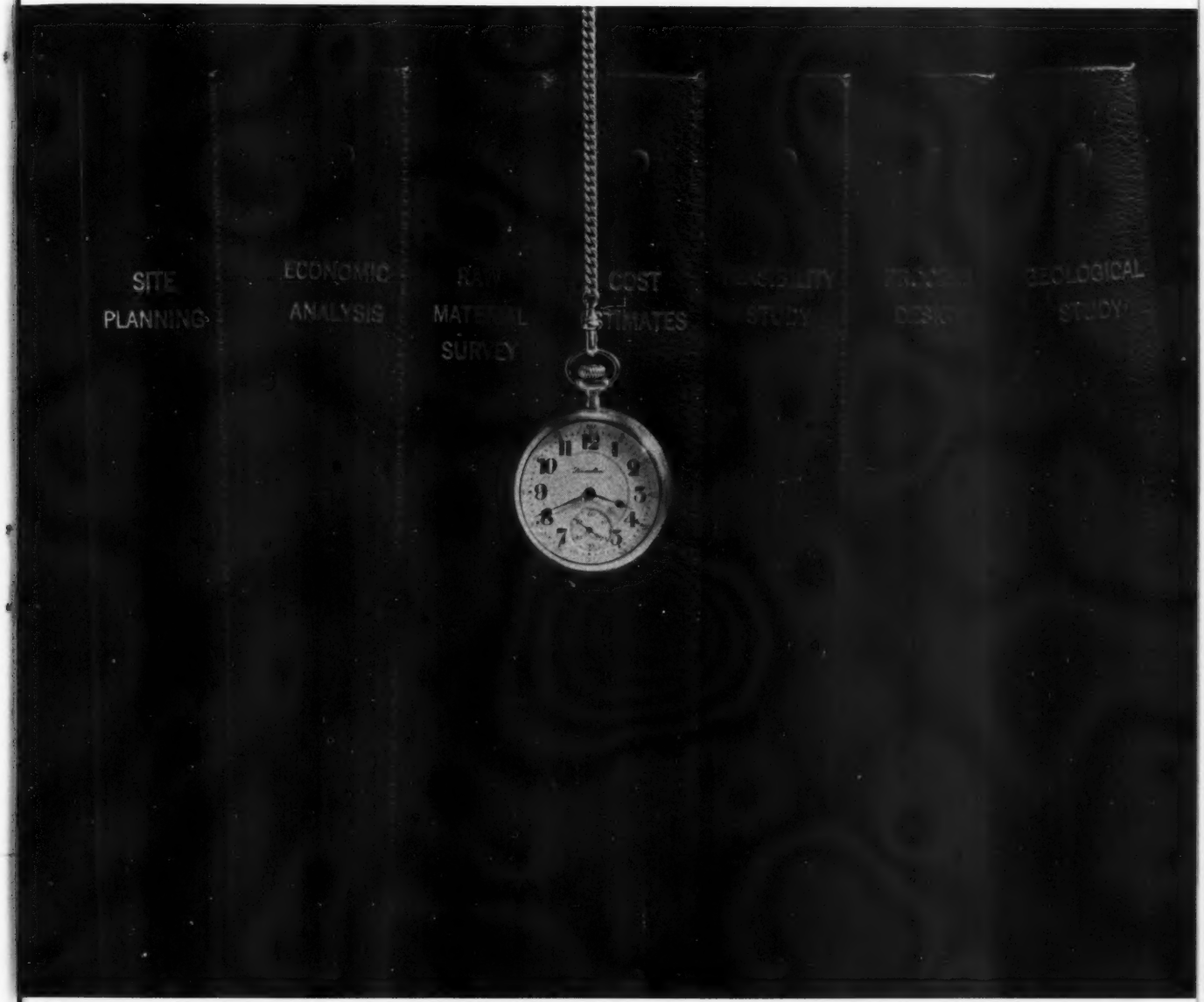

Timely? Many complex factors shape the final decision to proceed with your expansion plans...and timing is an important one. Independent analysis of all aspects of your proposed program is the *Pre-Engineering* service offered by Kaiser Engineers. The studies and evaluations furnished by KE Pre-Engineering represent only one phase of total KE services. Kaiser Engineers is an experienced designer and builder of all types of facilities for the Minerals industry. From Pre-Engineering through design and construction, Kaiser Engineers provides complete, one-company service and ingenuity based on years of experience.

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all your equipment
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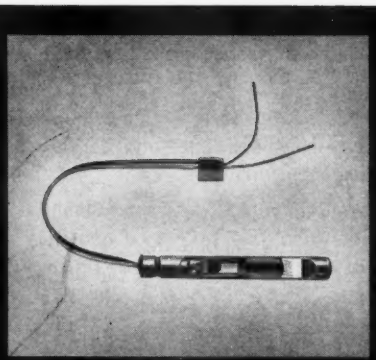
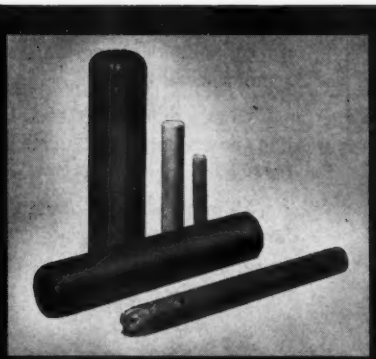
produces more.

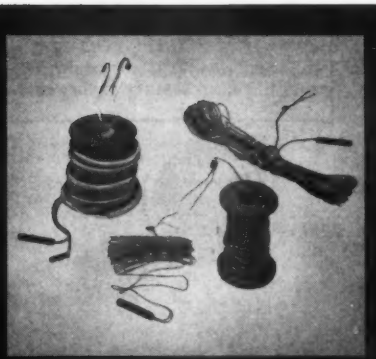
ATLAS PELLETS, a new form of ammonium nitrate, have both the density and sensitivity required for efficient ammonium nitrate blasting.



MANASITE® gasless delay electric blasting caps, most uniform timing in the field because of Atlas electric match and delay compound.



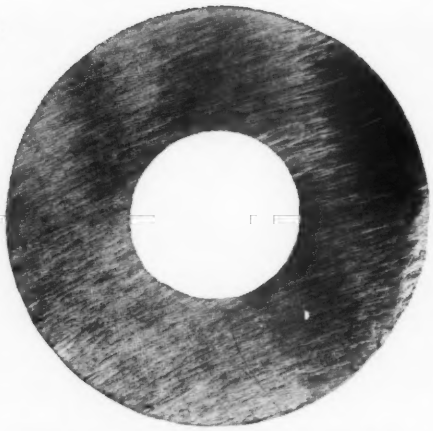
GIANT GELATINS for high velocity shattering action. They are advantageous for extremes of wet work and for hard, tight shooting.



ROCKMASTER® electric blasting caps achieve the staggered action so important in producing better breakage and control.

ATLAS EXPLOSIVES

Cross section of average extension steel, showing distorted center hole.



Cross section of Sandvik Coromant Steel, showing perfectly uniform center hole.

See for yourself why

SANDVIK Coromant Steels

last longer on the job!

Sandvik-originated smooth rope-threads make uncoupling easy.

PROGRESS THROUGH BETTER TECHNOLOGY

BLUE RIBBON MINING AWARD 1960

The completely unretouched photographs above show clearly why Sandvik Coromant large-diameter extension rods last longer! Since Sandvik takes the time—and the trouble—to cold-roll these alloy drill rods, the flushing hole is uniform all the way through—smooth as a gun barrel. And, since the hole is even and perfectly round, you set up fewer strains and stresses **in use**...there's less whipping... and therefore, less breakage. And, with mechanically stronger rods, we can provide larger flushing holes for faster, more complete removal of cuttings.

What's more, the Sandvik-originated rope-thread makes coupling and uncoupling a hand operation—speeds the job—and reduces chance of incipient cracks developing from wrench marks.

All in all, you can't beat Sandvik Coromant Rope-Thread Steels for fast work and long life! Available from 1½" to 2" in diameter. To set up a test on **your** job, write to your nearest Atlas Copco office today. Address: Dept. MCJ-17.

Atlas Copco

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610 Industrial Avenue
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UNEQUALLED MINING ACCEPTANCE!

UNRIVALLED MINING EXPERIENCE!

Scandura®

GOLD LINE

The ORIGINAL PVC MINE BELTING

First in the mining field, first in sales and performance, Scandura is the solid-woven polyvinyl chloride belting that made all the records in the beginning . . . and is building the most today! Months and years of experience on some of the most difficult applications ever assigned to conveyor belting give the crown to *Scandura* —the lighter weight, flexible, oil resistant belting certified fire resistant, immune to ply separation, mildew and rot under the worst conditions. Scandura Gold Line holds the cost line, too! See your National Mine man for quotations on your needs.

Manufactured in Charlotte, North Carolina by Scandura INC.

Exclusive Distributor

National Mine Service Company

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NOW...
60 and 42-ton HAULPAKS®

QUICK SPECS ON LW HAULPAK TRUCK LINE:

60 TON

550-hp Cummins VT-12-700 Diesel. Allison Torqmatic transmission with 6 speeds forward to 46.6 mph. Net weight 62,000 lbs.

42 TON

430-hp Cummins VT-8-430 Turbocharged Diesel. Allison Torqmatic transmission with 6 speeds forward to 47.8 mph. Net wt. 52,950 lbs.

32 TON

380-hp Cummins NT-380 Diesel. Allison Torqmatic transmission with 6 speeds forward to 38.8 mph. Net wt. 44,950 lbs.

27 TON

335-hp Cummins NRTO-6-BI Diesel. Allison Torqmatic transmission with 6 speeds forward to 35.4 mph. Net wt. 43,020 lbs.

22 TON

320-hp Cummins NHRS-6-BI Diesel. Allison Torqmatic transmission with 3 speeds forward to 22.3 mph. Net wt. 42,500 lbs.

to boost your production

In all 5 LeTourneau-Westinghouse Haulpaks you get production advantages no other off-road hauler can offer!

Hydrair® suspension

Haulpak rides on air, not steel. *No* springs, *no* front-axle or related maintenance. Less deadweight. High, 20 to 28-inch ground clearance, short turns. Four simple Hydrair units cushion load and road shocks, keep load riding level.

"Bonus-tonnage" V-body

Consider the extra load capacity you get within short wheelbase. Deep V-body carries about 6 tons of material below normal floor-line. Center of gravity is *low*. Exhaust-heated body prevents material from sticking or freezing-in.

Power-transfer differential

Now, for the first time on a truck, you get the job-proved LW power-transfer differential. In soft, muddy going, differential *automatically* slows slipping wheel, transfers up to *4 times* the tractive effort to drive wheel on firmest footing.

Short turn maneuverability

Haulpak turns in ⅓rd less space than comparable-capacity haulers, and much shorter than many smaller rigs. You have short wheelbase . . . and sharp-angle turn, because there's no spring or axle obstruction at front wheels.

More net usable power

Engine power is conserved many ways: light-weight super-strong steels used throughout body and frame . . . short simplified drive train . . . "power-miser" fan (requires only 10 hp, compared with 30 to 35 hp needed for conventional fans). Thermostatically-controlled fan also starts or shuts off *automatically* as needed . . . releases more horsepower for extra tractive effort.

Other cost-cutting features

Multi-disc air brakes (biggest, safest in the industry) . . . quick accessibility (reduces servicing time) . . . interchangeable tires, Hydrair units and other components (you can operate a Haulpak fleet on a *minimum* parts inventory).

No matter what the size of your operation . . . or your hauling problems . . . LW Haulpaks can give you bigger production at lower cost. We'll be glad to give you complete details and to arrange a demonstration . . . no obligation.

HP-2355-G-2

LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

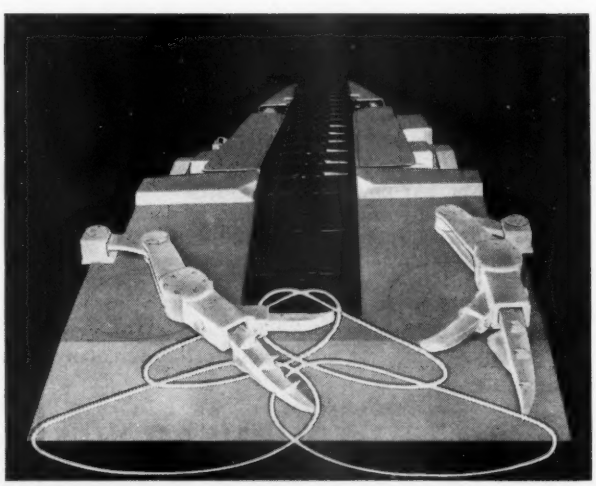
NEW DOUBLE-ARM GATHERING DESIGN MULTIPLIES LOADING EFFICIENCY

No other loading machine even approaches the new LONG-AIRDOX 188-3 in overall performance, economy, and versatility. One reason is the 188-3's exclusive reverse link, double-arm design.

This new concept in loader construction offers these important benefits: shorter, more powerful strokes (with 30% more torque per stroke); faster, more positive gathering; less scattering of material; higher tonnages; greater efficiency.

Other advantages provided by the 188-3 include: savings on maintenance and parts inventory resulting from the simplified single motor design, better maneuverability due to independent crawler control, flatter head angle, and unusually good balance.

Available in heights 23½" and up, with capacities to 12 tpm, 188-3 loading machines are applicable to all popular mining systems. For details or a demonstration, write Long-Airdox Company, Division of Marmon-Herrington Company, Inc., Oak Hill, W. Va.



LONG-AIRDOX

Thor

Announces TWO great new Push Feed Drills···

and more!

MODEL 330, with new larger bore, out-performs anything in its class.

MODEL 440, with 50% longer stroke, shatters all records for fast penetration in hardest rock!

And there's more · · ·

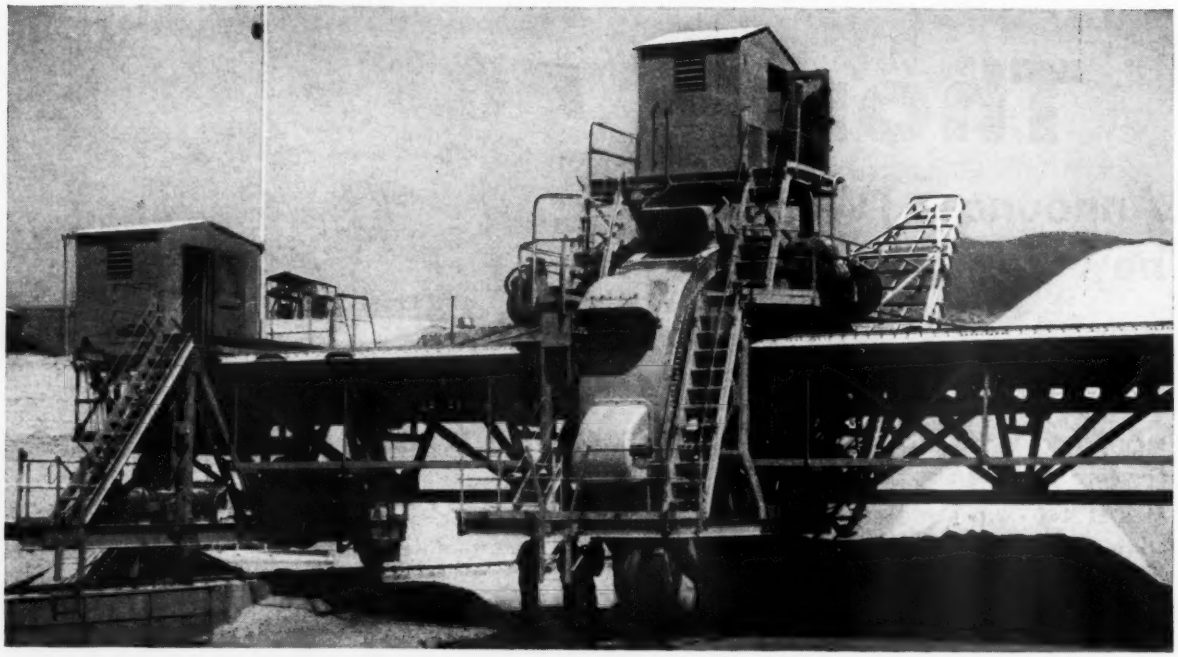
New Power-Retracted Legs for either the Model 330 or Model 440 up to 51-inch feed!

New Telescopic Legs for either the Model 330 or Model 440—up to 72-inch feed!

The all-new Thor Push Feed equipment has dazzled mining people everywhere it has been demonstrated—with tremendous penetration, plus new simplified controls that make it the easiest to use equipment on the market today.

Don't get caught napping! Write now for a demonstration on your property. Thor Power Tool Company, Aurora, Illinois. Branches in principal cities.

Thor POWER TOOLS



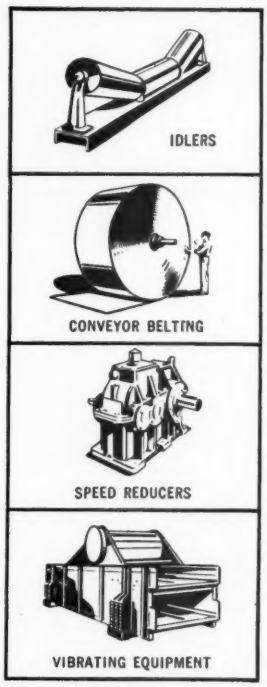
BIG WHEEL

It blends... it reclaims... it ends inefficiencies of selective mining

As part of a new H-R Rotary Bucket Wheel Blending and Reclaiming System, this giant 3-story wheel is capable of processing efficiently a broad range of materials . . . especially where more than one of the following typical situations exist:

1. Engaged in selective mining
2. Unable to comply with specifications
3. Too much coarse or fine material in feed
4. Storage pile requirements range 50,000 tons and over
5. Two or more types of raw material to blend for chemical compounding.

For full details consult your H-R representative, or write Hewitt-Robins, Stamford, Connecticut. Ask for Bulletin 11-15.



HR HEWITT-ROBINS

THE NAME THAT MEANS EVERYTHING IN BULK MATERIALS HANDLING SYSTEMS...

CONVEYOR BELTING AND IDLERS • INDUSTRIAL HOSE • VIBRATING FEEDERS, SCREENS & SHAKEOUTS • POWER TRANSMISSION EQUIPMENT

IN ANY SEAM OR PIT CONDITION COMPTON AUGERS GIVE YOU THE LOWEST COST PER TON

The complete range of Compton's line of augers—from 20″ triples to 8′ singles—means a low cost per ton can be achieved in any seam, under any pit conditions. The percentage of good coal is very high, too, for all models are equipped with Compton "lump recovery" cutting heads.

Compton Augers are designed for "high-ball" operation and quick shifting of locations. They are completely self-contained. Auger sections are racked up within the machine frame, ready for quick transfer to operating position, by means of the hydraulically controlled, synchronized winches. The elevating conveyor is an integral part of the auger. All models are available with a self-propelling feature.

For full information on how to cut your highwall mining costs with Compton Augers, write for literature or consult your Joy representative.

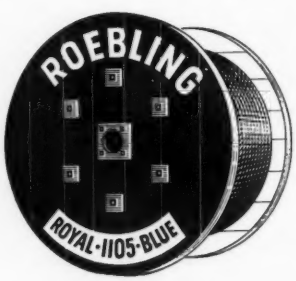
Compton, Inc.

SUBSIDIARY OF JOY MANUFACTURING COMPANY

BOX 1946—CLARKSBURG, WEST VIRGINIA

ROEBLING ROYAL BLUE WIRE ROPE

WE PUT A LOT OF WORK INTO IT—YOU GET A LOT OF WORK OUT OF IT



This happens to be the inside view of Roebling Royal Blue — its core has been removed to show the uniformity and symmetry of the rope structure. You see how concerned we are with internal security.

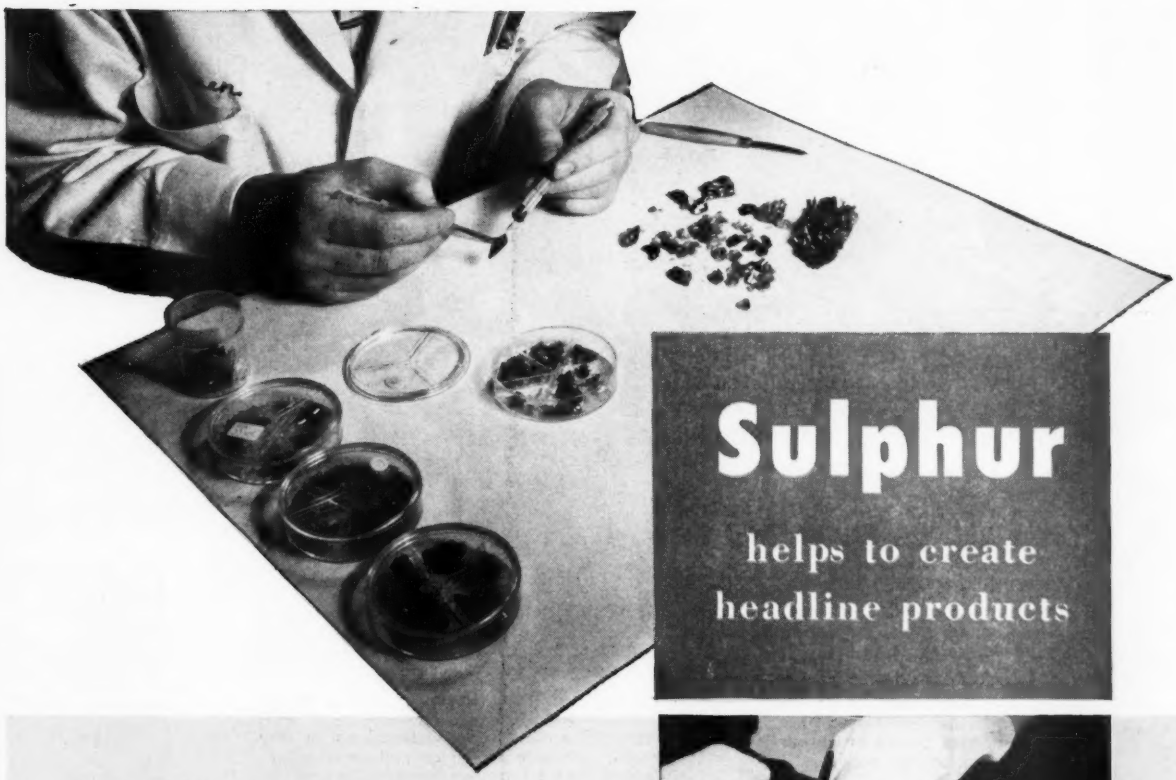
We have to be. To make sure that Royal Blue will live up to the day-to-day demands made upon it. High stresses and unavoidable overloads, abrasion, fatigue, impact, crushing, sheave pressures and abusive drum-winding, to name the major ones.

Royal Blue goes through many inspections and tests—both internal and external —before reporting to work. This way we're sure that the rope we build will do what we sell it to do. These quality-control measures are your assurance that Royal Blue is made to save you money — anyway you look at it.

For details about hard-working Royal Blue, ask your wire rope distributor or write Roebling's Wire Rope Division, Trenton 2, New Jersey.

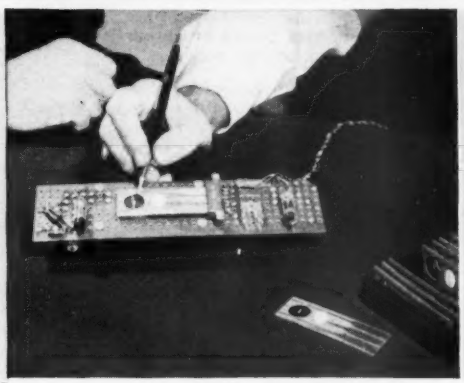
ROEBLING

Branch Offices in Principal Cities • John A. Roebling's Sons Division • The Colorado Fuel and Iron Corporation



Sulphur

helps to create headline products



CdS • • • *a new concept in field-effect transistor design*

General Motors Research Laboratories has recently announced the application of a new transistor material ... the cadmium sulphide crystal which offers several distinctive values over the single type atomic material. Its outstanding characteristic is that it is controllably sensitive to and affected by light and other radiations.

CdS provides another interesting development where Sulphur is importantly in the picture ... a development that may have far-reaching effects in the broad field of electronics.

Sulphur and its many derivatives, either directly or indirectly, have a part in the creation of countless products, adding to the strength of our economy. Our business is to produce Sulphur—molten as well as solid—and have it available in sufficient tonnages at several departure points to serve any plant in the United States or Canada. Supplementing this basic policy, we are developing centralized distribution centers for quicker service.

TEXAS GULF SULPHUR COMPANY

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Sulphur Producing Units: Newgulf, Texas • Spindletop, Texas • Moss Bluff, Texas • Fannett, Texas • Worland, Wyoming • Okotoks, Alberta, Canada

UNION

The *S. O. S. Wire Rope Organization

**Service on Schedule*

Delayed action on distress signals for wire rope can set up a chain reaction of downtime losses.

With hundreds of selected distributors surrounding a hard core of 15 strategically located and expertly staffed branch offices and warehouses Union is uniquely organized for quick rescue service.

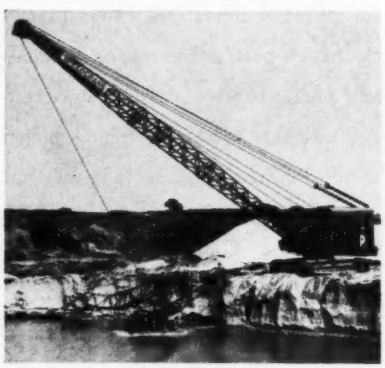
Give this same organization the opportunity and it will help cut down the need to send distress signals. How? Through Union's free preventive service. It guides you in the application of the right wire rope. It uncovers faults in equipment and abuses in wire rope operation which cause excessive wear and overloading.

Customers tell us that Union's preventive service, coupled with quality so good it makes Union the ultimate low cost rope, is helping substantially to battle against rising operating costs. Here's how customers have benefited in other ways from Union's years of preventive service.

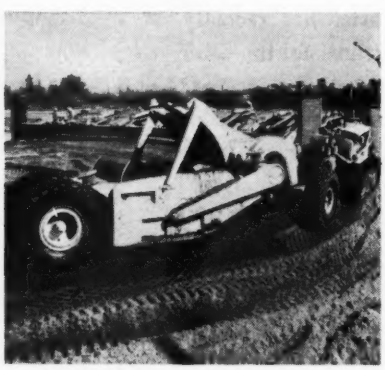
Union engineers sometimes found it impossible to select exactly the right rope from 1600 standard constructions in day to day production. To correct these situations Union laboratory researchers and engineers developed the Tuffy family of special purpose wire ropes and slings. Tuffys are engineered for equipment which imposes extraordinary tough jobs upon wire rope. Each Tuffy is a special construction but in all of them is a balance of strength, toughness and flexibility tailored for longer service life.

Tens of thousands of applications have proved Tuffys to be the ultimate low cost wire rope or slings.

Tuffy Wire Ropes and Slings are "Job Prescribed" for Tough Jobs



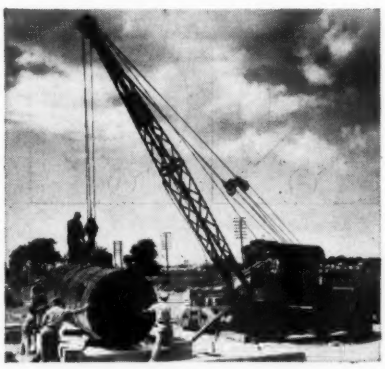
Tuffy Balanced Dragline Rope



Tuffy Balanced Scraper Rope

Tuffy Balanced Dozer Rope

Helicopters, long noted for their disaster missions, are becoming "work horses" in the air. Equipped with wire rope and slings they pick up and set materials and machinery down in inaccessible places and carry hurry up loads to otherwise easy to get to places. Photo courtesy Bell Helicopter Corporation, Ft. Worth, Texas.



For the Right Wire Rope and Service-On-Schedule: Call Your Union Distributor

You'll find him listed in the Yellow Pages — ready with the top-quality Union Wire Rope products you need, and advice on any wire rope problem. Union Wire Rope Corporation, 2144 Manchester Ave., Kansas City 26, Mo.

Tuffy Balanced Slings and Hoist Lines

Tuffy. Wire Rope Tips

Money-Saving Ideas on the Use and Care of Wire Rope

How to Check Groove Diameter

Not Quite

Just Right

Groove diameter of a sheave or drum must never be less than the actual calipered diameter of the new rope. When a new rope is installed on old equipment, use a reliable groove gauge to make sure the tread or bearing surface of all sheaves is of sufficient size to avoid pinching the rope.

Recommended Sizes

Diameter of Rope	Min. Dia.	Max. Dia.
¼-⅞	+ 1/64"	+ 3/32"
15/16-¾	+ 3/32"	+ 1/16"
7/8-1⅛	+ 3/64"	+ 3/32"
1¼-1½	+ 1/16"	+ ⅛"
1⅝-2¼	+ 3/32"	+ 1/16"
2⅜ and larger	+ ⅛"	+ ¼"

New ropes are usually oversize. It is advisable to have groove diameters of sheaves or drums as large as the actual calipered diameter of the new rope, or slightly larger.

Use the Right Fittings

Right fittings add life expectancy to wire rope. Fittings which derive holding power from crimping action are harmful. Shown here is a clamp that has no "wrong side"—can be put on either way. It snugly saddles the rope, grips larger surfaces in such a way that loads are carried almost entirely by friction instead of crimping action. Combined in its two parts is a thimble. The parts are interlocked to prevent collapse of the thimble, and eliminate all shear on the bolts.

Would you like a copy of a booklet in which more than a score of Tuffy Tips like those above are reproduced. If so, write Union Wire Rope Corporation, 2144 Manchester Ave., Kansas City 26, Missouri.

UNION Wire Rope

Subsidiary of ARMCO STEEL CORPORATION

OTHER SUBSIDIARIES AND DIVISIONS: Armco Division • Sheffield Division • The National Supply Company
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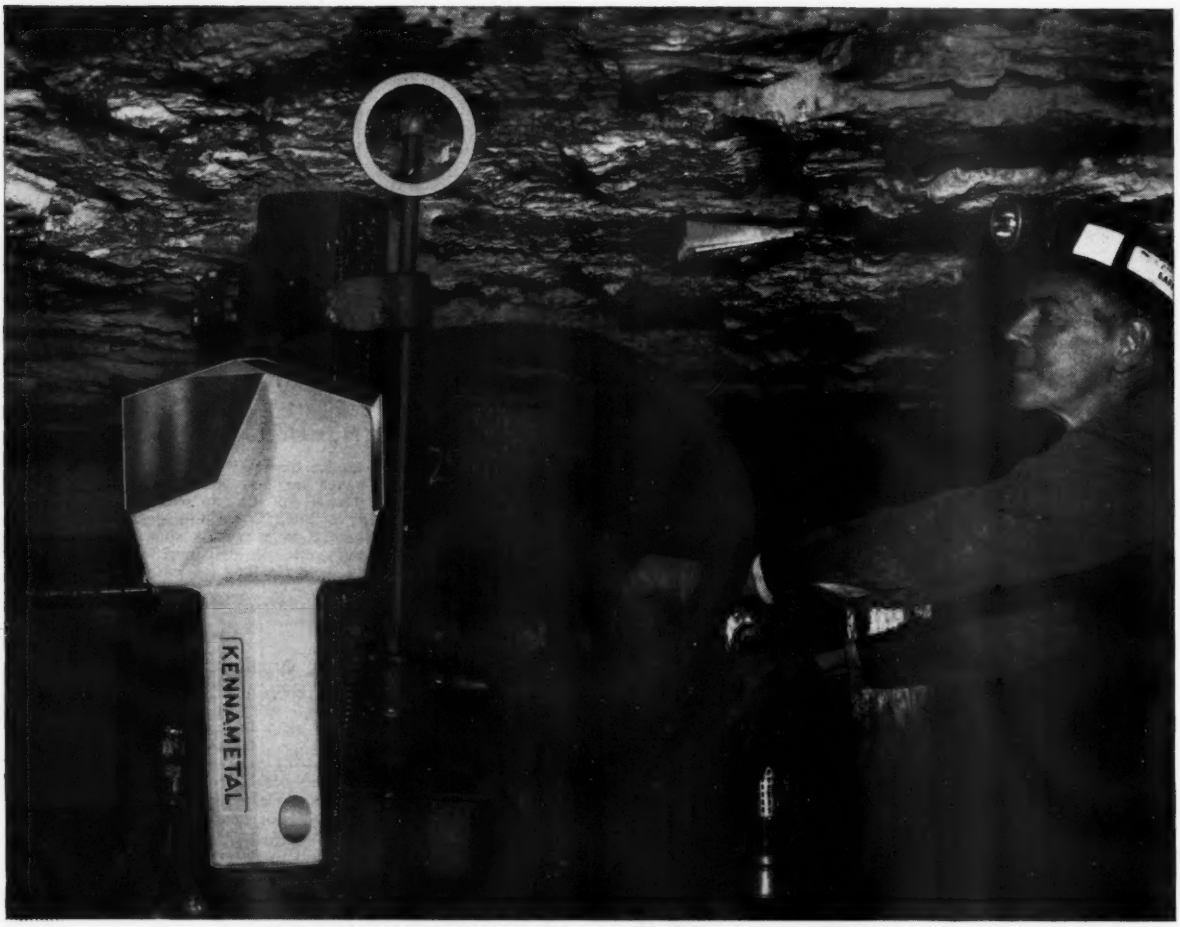
4-C



At the point of penetration is where roof bit performance really counts.

For FAST PENETRATION ...try the new KENNAMETAL FDC ROOF BIT

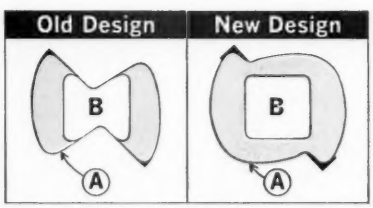
This new Kennametal Roof Bit is designed to take full advantage of today's more powerful rotary and rotary percussion roof drills. In drilling 1⅜" to 1¾" diameter holes, this bit gives rugged, dependable performance under the most severe roof conditions. Here are the reasons why:

Through elimination of the water groove and complete redesign, the seating surface (see area "A" in sketch) between the base of the bit and the drill steel chuck has been increased substantially. This provides more rigid support to the bit, eliminates troublesome bit wobble, and contributes to longer drill steel life. It is advantageous to have the forces distributed over a larger seating area—particularly where high thrust or rotary percussion-type drills exert even greater wear and impact on the drill steels and bits.

Another improvement, the square shank (see area "B" in sketch), allows for increased cross sectional area, which in turn means greater strength and rigidity.

The shape of the FDC Bit forging has also been changed to speed removal of cuttings from the hole. This new shape directs cuttings away from the shank and chuck, where packing would cut drilling efficiency.

Remember . . . bits may look the same, but the difference shows up in performance. And roof bit performance begins at the point of penetration. Why not drill a few test roof holes at your mine with this new Kennametal bit? See for yourself. Contact your Kennametal Representative. He can provide a style of Kennametal bit designed for most effective drilling in any roof formation. Call him or contact us direct. KENNAMETAL INC., Mining Tool Division, Bedford, Pennsylvania. Phone Bedford 755. 33560



INDUSTRY AND KENNAMETAL ...Partners in Progress

AMERICAN MINING CONGRESS

A Declaration of Policy

Adopted at Las Vegas, Nevada, October 10-13, 1960

MEN of daring, courage and initiative over the years built the great mining industry of America under the private enterprise system. Without the mining industry and the production of metals, minerals and fuels in abundance, this Nation could not have survived the major wars of this century. Without a strong and stable economy in which our industry plays such a vital role, this country, with its high standards of living, will be unable to survive in a world of conflicting ideologies. Today America needs a healthy mining industry more than ever before. Continued neglect of our problems will have the gravest consequences in the future. Both major parties have gone on record in favor of a long range mineral policy for the Federal Government. We are interested in action rather than promises.

The resolutions which follow call for wisdom in the use of our resources and a strong national minerals and solid fuels policy.

NATIONAL MINERALS POLICY

The need for a National Minerals Policy to assure the achievement and maintenance of a healthy minerals industry has been recognized for many years and has been repeatedly endorsed by members of Congress and Government officials.

Legislation was enacted more than a year ago requesting the President to review existing mineral programs for the purpose of providing increased production and employment in critically depressed segments of the mining industries; to advise Congress at the earliest possible date as to remedial action taken or proposed, and to submit to Congress a reorganization plan concerning mineral activities within the Government and recommending administrative changes and legislation necessary to construct a wise and practical minerals policy. On May 19, 1960, the Deputy Assistant to the President submitted a report to the chairman of the House Committee on Interior and Insular Affairs summarizing past and present Government activities affecting the mineral industry of the United States. While many of these activities have been and are beneficial to the industry, little progress has been made toward alleviating continued depressed conditions in certain domestic minerals.

The mining industry has repeatedly offered and stands ready to furnish technical advice, guideposts and principles to help develop a National Minerals Policy and to put such a policy into effect. The major policies urged by the industry are as follows:

IMPORT CONTROLS

Adequate import duties or tariff protection, properly applied, are necessary to maintain many important segments of the domestic mining industry. With respect to certain metals and minerals of which the United States produces a substantial portion of our domestic requirements, adequate import taxes should be established, to

be imposed if and when the average monthly price falls below a reasonable prescribed point legislated for each metal and mineral respectively. With respect to metals and minerals whose domestic production is sufficient only to provide a small percentage of our requirements, adequate programs in line with the particular circumstances (such as allocation to domestic producers of duty collected from the imports of the particular commodity) should be instituted and maintained to encourage continuance of such industries.

When protection is accorded to any metal or mineral, such protection can become realistically effective only by establishing equivalent compensatory custom treatment on related metal or mineral items, including fabricated, semi-fabricated and derivative products.

Provisions should be adopted by Congress to authorize escape-clause proceedings for all metals and minerals not now eligible therefor because of the technicality that the duties thereon have not been reduced since 1934.

Import quotas should be used only when no other adequate procedure is practical and available.

ANTI-DUMPING MEASURES

The Anti-Dumping Act of 1921 was intended to prevent the sale of foreign goods in this country at prices less than their value in the country of origin. However, the procedures for implementing this Act, even as amended in 1958, are such that in practice domestic industry has not been provided with effective protection against dumping.

Procedures under this Act should be revised to speed up and implement findings as to whether or not foreign goods are being imported at less than their fair value.

STOCKPILING

The Nation's stockpiles of strategic minerals and metals should be filled and maintained at levels unquestionably sufficient to meet all national security requirements. Generally, we believe it is wise and advisable to dispose of or utilize these security resources only to meet security requirements. It may be necessary from time to time to have the industry process some of these materials into a more readily usable form. Experience since World War II has shown that concepts of material requirements for the national defense change radically from time to time. Reduction of holdings of a given commodity because of an apparent surplus always runs the risk that later developments will occur pointing to increased requirements. Therefore, any surpluses to be disposed of should only be sold under a plan formulated after consultation with representatives of the industry involved and with the appropriate committees of the House and Senate. Further, such plan should provide for sale only through domestic producer-marketing channels and in a manner and at such times that prices and established markets will not be adversely affected.

The barter program should not be utilized to supply current Government mineral requirements nor to acquire minerals, metals or alloys for which stockpile objectives have been filled.

Certain segments of the minerals industry have been in a critical stage for many years and we urge the Administration and Congress to give their immediate attention to the above recommendations in order that, at long last, a National Minerals Policy will be adopted.

GOVERNMENT EXPENDITURES

Determined and effective action is needed to balance the budget. Federal governmental activity should not extend to those matters which the people themselves, through private enterprise or their local or State agencies, are able to carry out.

The Federal Government should refuse, during the period of high defense expenditures, to embark on new programs not of immediate necessity.

Economic disaster lies ahead if Government expenditures continue over the long run to exceed revenues. To prevent such disaster, the reduction of Government expenditures should be accompanied by a reduction of tax rates to a level which will increase the tax yield by stimulating economic activity.

TAXATION

The Nation's minerals must be made available to maintain the dynamic and expanding economy which is so vital to our general welfare and to all the people of the Free World. Finding and developing new reserves to replace those exhausted must be encouraged. The costs, the risks and the failures are constantly increasing. Profits, after taxes, must be adequate to furnish needed incentives if we are to have a continuing supply of the required minerals.

With respect to income taxation, it is essential that adequate percentage depletion allowances be

provided, at not less than present rates. The present depreciation provisions must be liberalized to stimulate investment of the funds necessary for a dynamic economy. Our present depreciation policies stifle economic growth because they fail to cope with the problem of inflation and to deal adequately with the increasingly significant problem of technological obsolescence.

In the case of State and local taxation, failure to grant an adequate depletion allowance, or failure to keep taxes within reasonable limits, will discourage the development of the mining industry and result in reduced revenues.

We particularly urge upon the Congress of the United States the following:

Exploration expenditures should be fully deductible and present limitations should be removed.

The present high income tax rates should be reduced to restore adequate incentive for investment risk, economic effort and initiative. Their reduction will benefit the economy and yield increased revenues to the Government.

The limited allowance now made to stockholders on dividends with respect to taxes paid by the corporation should be extended. The depletion allowed to a mining corporation should be carried through to the stockholder on an adequate and equitable basis. Intercorporate dividends should not be doubly taxed.

As a result of the past and continuing cheapening of the dollar, it is vital that our methods of computing taxable income be adjusted to avoid the confiscation of capital, and to recognize that most capital gains during periods of inflation of the dollar are a reflection of such inflation rather than taxable income.

The income tax laws of the United States should encourage the economic development of underdeveloped countries by private capital, rather than through the use of Government funds at the expense of our taxpayers. Where protection of domestic production against imports is necessary, it should be provided by means other than a differential treatment in the income tax laws.

LABOR LEGISLATION

The necessity for Congressional action designed to eliminate labor monopoly power has again been forcibly demonstrated during the past year. The protracted strikes in the mining and steel industries, the increasing prominence in these and other labor disputes of the issue of management's rights, the Supreme Court's elimination of effective judicial review of arbitration proceedings, and the recent decision of the National Labor Relations Board in the Kohler Case which has the effect of condoning mass picketing and violence, give a clear warning to the Nation that, unless the growth of labor monopoly power is soon checked by realistic Congressional action, the national economy will succumb to labor socialism.

The concern of the 86th Congress over the problems of racketeering and corruption in labor unions which resulted in the passage of the Landrum-Griffin Act, while both justified and laudable, nevertheless tended to divert attention from this basic problem. Racketeering and corruption, both highly deplorable, are but symptoms of labor monopoly power. Far greater consequences of that power are the economic enslavement of the industrial wage earners of America through coercion and compulsion, the increasing domination of government through massive political expenditures by unions, and the imposition on American industry of unproductive costs which destroy our ability to meet foreign competition both at home and abroad. These are the dire consequences which have been generated for several decades by national labor policy.

Time is running out on the free enterprise system which has made America strong. Congress can no longer ignore one of the basic causes of that situation—the privileges and immunities vouchsafed exclusively to labor unions by Federal law. Labor monopoly power cannot be eliminated by piecemeal attacks on its symptoms. Its sources must be uprooted. We urge Congress to give immediate attention to this vital problem. We recommend the following as the essential elements of effective legislation:

1. **Application of the principles of the antitrust laws to labor unions.**
2. **Prohibition of compulsory unionism in any form.**
3. **Removal of union immunity from injunctions in Federal courts.**
4. **Elimination of Federal compulsion with respect to the procedures and subjects of collective bargaining.**
5. **Effective prohibition of mass picketing.**
6. **Effective prohibition of the use of union funds for political activity.**

We oppose the enactment of legislation permitting "common situs" picketing on construction

projects. This is a subterfuge to destroy the secondary boycott prohibitions of the Taft-Hartley and Landrum-Griffin Acts. We also oppose the enactment of Federal legislation setting minimum standards for the amount and duration of benefits to be paid under State unemployment compensation laws. Federal control in this field is a cornerstone of labor socialism.

Efforts to enact labor legislation for political gain are to be condemned at all times. Seldom have they been more apparent than during the most recent sessions of Congress. The need for additional Federal labor legislation cannot be questioned. But such legislation should be designed to eliminate labor monopoly power, not merely to cater to the dictates of that power.

SOLID FUELS

The potential dangers in the present world situation make it more essential than ever that we in this Nation have a planned, comprehensive program of conservation and proper utilization of our natural fuel resources, which will enable us to meet the energy challenge of the future. Our Nation's economy is dependent upon the availability and efficient use of our energy resources.

Recognizing the vital importance of coal as the primary energy fuel upon which the Nation can rely for centuries to come, we reaffirm the necessity for safeguarding coal productive capacity and a transportation industry which is at all times equipped to handle coal production.

It must not be overlooked that the availability factor for oil and gas quickly reaches the danger point in national emergencies. Natural gas is committed beyond its ability to meet emergency needs or unusually severe weather requirements.

We commend Congress and the Administration for creating an Office of Coal Research within the Department of the Interior and establishing a broad coal research program to augment the research conducted by the U. S. Bureau of Mines and by the coal industry. We pledge our assistance and cooperation to this new agency in its efforts to develop further uses for coal.

The combined efforts of the coal industry, the United Mine Workers of America, coal-carrying railroads, electric utilities and coal equipment manufacturers to achieve these objectives should be continued and strengthened.

We recommend and strongly endorse the following policies to assure fair consideration for the Nation's solid fuels industry and to protect the national interest and security:

1. **Establishment of a National Fuels Policy which will assure the sound economic position of the coal industry, bearing in mind its strategic indispensability in time of both peace and war. This policy should provide, among other things, for regular appraisals of the coal industry's capacity to meet the requirements of national security, current and projected, and to perform adequately its vital role in meeting national emergency needs.**

2. **Adoption of sound economic and conservation principles governing the sale and distribution of natural gas.**

3. **Continuation of existing mandatory restrictions on importation of crude petroleum and refined products, including residual fuel oil, with further reduction in the volume of imports of residual oil to the proportion which such imports bore to the domestic production of crude oil in 1954, as recommended by the President's Advisory Committee on Energy Supplies and Resources Policy in 1955.**

4. **Increasing the percentage depletion rate for coal and lignite in recognition of the fact that the replacement cost of coal mines has greatly increased within the past ten years.**

PUBLIC LANDS

Productivity and full utilization of the public lands should be a fundamental principle in the maintenance of our military strength and economic growth.

We believe that the public interest is served by assuring that the public domain is kept open for prospecting and the location of minerals. We therefore oppose the withdrawal of any area or any extension of a closed area unless it is established that the closing of an area is of far greater importance to the national welfare than the full utilization of such area for the development of its potential mineral resources. We believe that existing withdrawals should periodically be reviewed and reduced and the area of new withdrawals strictly limited, to the end that public lands closed to prospecting shall be kept to a minimum.

The enactment of any measure or establishment of any rule or regulation, or the determination of any executive agency, which would preclude or obstruct or limit access to or utilization of the mineral and other natural resources on the public domain, is contrary to the public interest—not only of the States directly affected but of the Nation—and is vigorously opposed by the American Mining Congress.

The system established by the General Mining Laws for the location and patenting of mining claims has proven successful in encouraging and providing for development of the mineral resources of the public domain through private initiative and enterprise; however, in order to facilitate the discovery of deep-lying ore bodies, we favor legislation which will, without destroying the principle of our present mining laws, afford reasonable prediscovery protection to one who is in good faith engaged in exploratory work.

We recognize the problem presented by the extension of urban areas upon land the surface rights of which are privately owned and the mineral rights within which have been reserved to and are held by the Federal Government and are subject to disposition under the General Mining Laws. It being inherent in our law and vital to the public interest that mineral deposits within the public domain be discovered and developed, we reaffirm the right of the prospector to search for and develop such minerals. We favor legislation which in such cases will require the payment of just compensation for actual damage to the surface resulting from mining operations.

We endorse the efforts of the Department of the Interior to persuade the Federal Power Commission to refuse to license construction of dams and reservoirs which would destroy known mineral resources. Wherever such a conflict exists, we urge that the extraction of the mineral resources must, in the public interest, be given priority and that the development of the power resource be deferred until the mineral resource has been depleted. If the order is reversed, the mineral resource will be lost forever.

We believe that the prevailing rule that the validity of administrative rulings of the Secretary of Interior with respect to mining claims can be challenged only in a proceeding brought in the District Court of the District of Columbia places an undue burden on owners of such claims. We therefore favor legislation conferring jurisdiction to review such determinations on the U. S. District Courts in the district in which the mining claims are situated.

We commend the Department of the Interior and its Bureau of Land Management in the administration of the General Mining Laws in a manner consonant with the spirit and purpose of those laws and with recognition of long established principles as to what constitutes a sufficient discovery upon a mining claim. We believe, however, that any holding that a mineral deposit is not a "valuable" mineral deposit or that it has no "economic value" where the claimant has expended and is willing to expend substantial sums in development of the deposit, or in the development of the means or processes to put the deposit to use, is not in accord with the mining laws. The fact that value lies in potential as well as in present use has been demonstrated by experience.

We urge upon the Department of Agriculture and its Forest Service, and the Department of the Interior and its Bureau of Land Management, that their regulations be administered uniformly in order that the development of our natural resources may be prosecuted without undue burden.

MINE SAFETY

Safety within the mining industry is of such critical importance that the prevention of personal injuries must continue to be a first consideration in all mining operations. Based on this premise, the industry believes that mine safety, together with new and better means of promoting it through unceasing educational effort, is primarily the responsibility of individual mining companies.

The more industry analyzes the problem, the more evident it becomes that success in safety is dependent upon individual responsibility encouraged and exercised at all times at all levels of supervision. Basic principles of safety apply everywhere; yet the industry is convinced that special problems require special solutions. For this reason, we maintain that the industry itself is best qualified to meet and overcome its own safety problems. This is best demonstrated by our steady and impressive progress in the safety field.

While united firmly in this philosophy, we recognize that in some areas certain governmental mining codes or regulations have been useful. However, this industry supports State rather than Federal control because the local governmental agency can best serve local conditions and situations. Duplication of mine inspection activities by various governmental agencies must be eliminated.

The industry takes cognizance of, and commends, the work and accomplishments of the U. S. Bureau of Mines during the past year for its many and valuable contributions in promoting safety education and accident prevention. It is our hope that the Bureau's work in this field may be intensified in the future.

WATER AND AIR POLLUTION

Water and air are among mankind's most basic resources—vital to man's existence and to the industry which sustains his constantly improving

living standards. Proper use and conservation of these resources are imperative.

Problems of water and air pollution arising from increased population and attendant industrial and urban growth are related to individual area situations; they are mainly local in character, but may affect more than one locality. The evaluation, solution and control of such problems are the responsibility and the right of the affected areas.

We urge that Congress give full recognition to this principle of local jurisdiction in any legislation which it may consider involving pollution control, investigations, research and grants-in-aid. With respect to grants-in-aid, Congress should insure that the State and local agencies administering grants retain full authority to determine the health and the financial needs of the affected areas, and to approve and supervise the distribution and use of such grants.

GOLD, SILVER AND MONETARY POLICIES

The gold and silver mining industries are plagued by paradoxes and contradictions in public policy. Thus, in a time of world-wide political uncertainty, the accumulation of reserves of strategic materials has been recognized as prudent public policy. Paradoxically, however, the Treasury pursues a contrary policy of selling at bargain prices two strategic materials that throughout history have been regarded as the "sinews of war." We refer to the monetary metals, gold and silver.

Some $5 billion of the United States gold stock, or 20 per cent of the total, has been sold to foreigners in the past decade at $35 an ounce, while at the same time U. S. citizens are forbidden to buy it. Foreign nations are now withdrawing U. S. gold at a rate which causes great concern. This cannot continue for long, but to date no adequate steps have been taken to correct the imbalance. We urge immediate corrective steps.

An anomalous policy is followed in regard to silver. At a time when coinage requirements are high and take more than U. S. production, the Treasury is selling its silver stock to industry at a 30 per cent discount from the statutory value and at less than world prices. In fiscal 1960 sales were in excess of domestic production. These sales deny producers a fair price for their product.

As demonstrated in World War I and World War II when U. S. Treasury silver was drawn upon in vast quantities to support the economies of Asia, this white metal continues to perform major monetary and economic functions throughout important areas of the world. The Treasury's general fund is now down from a maximum of 1,350 million ounces to around 150 million ounces. Treasury policy of selling this strategic material as rapidly as the market permits is shortsighted and inimical to the national interest. Treasury sales are inconsistent with the Congressional directive that "the proportion of silver to gold in the monetary stocks of the United States should be increased, with the ultimate object of having and maintaining one-fourth of the monetary value of such stocks in silver."

We therefore recommend that:

1. **The restrictions on the purchase, ownership and sale of gold by United States citizens be abolished.**
2. **The Administration recognize the historical and traditional confidence in gold and silver as monetary metals throughout the world, and as part of its foreign policy aid other governments in restoring gold and silver coinage—and currencies convertible into gold—as a standard of value and as a circulating medium.**
3. **Congress fix the ratio at which the dollar and gold are to be made fully convertible and take all steps necessary to provide for the orderly restoration of the gold standard.**
4. **The Treasury, prior to restoration of full convertibility, cease sales of gold for industrial uses.**
5. **The Secretary of the Treasury, under the discretionary powers granted him by the Act of July 31, 1946, cease sales of silver at less than the monetary value and retain the Treasury's dwindling supply of free silver for future subsidiary coinage requirements.**
6. **The Congress act to prevent the wasteful reduction of our silver stocks by immediately monetizing the presently held free silver and declaring inviolate the present monetary stocks, as well as insuring the supply of silver to our country by amending the Act of July 31, 1946 to eliminate the 30% seigniorage charge.**
7. **The tax on silver transactions be repealed and the buying and selling of silver for future delivery be allowed.**
8. **The Government give immediate recognition to the increased costs of producing gold within the United States by means of an increase in the price paid to domestic producers for newly mined gold.**

URANIUM

We commend the U. S. Atomic Energy Commission for recognizing that domestic producers are able to meet, with existing commitments, all currently projected uranium needs, as evidenced by

its action in not extending foreign source material contracts.

To date, no policy has been forthcoming from the AEC as to the Government procurement program after 1966. We urge that the Joint Committee on Atomic Energy undertake immediate study of Government requirements for uranium after 1966 and that it make its report available to the industry.

GOVERNMENT REORGANIZATION

There is general recognition that the costs of Government at all levels are too high, yet each year they continue to increase through undertaking of new services, extension of existing responsibilities and employment of more personnel. Rarely is a move made in the direction of economy and limitation of Government activities.

The great reports of the Hoover Commissions are guides to greater efficiency and lower costs in the Federal agencies, and works of similar committees in several States point in the same directions, yet their recommendations are far from translation into savings which might ease the taxpayers' burdens.

Once more we state our belief that one of the most serious problems for early solution is that of reorganization of Government agencies, elimination of overlapping functions in bureaus and divisions, consolidation of agencies wherever possible, and consistent refusal to add to the responsibility of local, State and national governments except as the safety of our country makes this mandatory. Economy and efficiency in government should become the top objective of political parties and other civic organizations.

U. S. GEOLOGICAL SURVEY—BUREAU OF MINES

The Department of the Interior is the mineral industry's high Federal agency charged with aiding its broad interests and those of the entire Nation through the activities of the Geological Survey and the Bureau of Mines. No other Department has so many responsibilities concerned with our natural resources and especially metals, minerals and fuels.

We express our confidence in the leadership of the Department and in the administrative and technical competence of the officers and staffs of the Geological Survey and the Bureau of Mines. We urge that their programs, including topographic and geologic mapping, resource conservation, explorations, research, economic studies, publications and mine safety be given fullest support at all times, and in the case of some, notably the Geological Survey's mapping schedule, be accelerated.

Funds for a new building for the Survey are long overdue. A large agency, operating in nearly twenty buildings in Washington, obviously cannot get the best results from its endeavors.

MINE FINANCING

Mineral reserves must be constantly and consistently replenished by finding, exploring and developing deposits in new areas and in recognized mineral districts. This process is a business generally requiring larger and larger amounts of venture and risk capital, as ore deposits are becoming increasingly more expensive to find and develop to a commercial stage. The raising of such capital from the sale of securities or otherwise should be accomplished without misrepresentation of essential facts or other abuses. Funds so obtained should be utilized in furthering the project for which they are intended and not misappropriated or dissipated for other purposes. While reasonable laws and regulations to forbid *mala fide* practices are justified, they must be framed with care so that they will not discourage, prevent, or make more expensive honest efforts to obtain the necessary money for financing mining ventures.

We continue to recommend consultation with, and offer the advice of, the experienced personnel of the mining industry to all branches of Government, and particularly to the Securities and Exchange Commission, in an attempt to insure that only measures that are constructive, sound and practical are adopted.

We commend the Congress for its refusal to enact the so-called "premerger notification legislation" which would require mining enterprises, now in fierce competition on a world-wide basis, to delay normal business transactions essential to survival and growth. We shall continue to oppose attempts by administrative action to impose notification requirements prior to corporate mergers or acquisitions, such as the Securities and Exchange Commission's proposed amendment to Form 8-K, Release No. 4089.

We recommend that the Department of the Interior take the initiative in a joint effort with the mining industry to reactivate the program of minerals exploration loan contracts, administered by the Office of Minerals Exploration, so that sufficient funds can be made available on a sound and realistic basis to help finance worthy exploration projects which cannot be wholly financed privately.

Part I — THE DESIGN OF AMMONIUM NITRATE-FUEL BLASTING AGENTS*

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Based primarily on data obtained from an explosives research program at the University of Missouri, Part I of this article considers the physical and chemical properties of ammonium nitrate. Emphasis is on the effect that particle size and density have on sensitivity and detonation velocity

BOTH physical and chemical properties of ammonium nitrate play dominant roles in the design of AN blasting agents. Some of the more important characteristics are described by Stites.[1] The various types of AN on the market may differ in physical properties, but chemically they are all the same. The primary interest in AN as an explosive ingredient results from its ability to furnish oxygen when it decomposes at high temperatures. The oxygen reacts with whatever combustible material may be present, i.e., carbon, fuel oil, etc., and the heat of reaction is increased by this combustion process. Physical and chemical characteristic data for AN are given in table 1.

The equation for the chemical reaction of AN depends upon the temperature, and upon the other ingredients present. Equations 1 to 3 are the chemical reactions when it is heated unconfined. Should it be confined, however, the burning can easily develop into an explosion. At higher pressures and temperatures characteristic of a detonation the reaction cannot be represented by a single simple equation except at oxygen balance, and chemical equilibria must be taken into consideration. Equations 4 and 5 give possible reactions for an oxygen balanced mixture and for pure AN. The addition of as much as six percent fuel oil almost triples the energy release.

1. $NH_4NO_3 \overset{180^\circ C.}{\leftrightharpoons} NH_3 + HNO_3$ (−41 kcal/mol)
2. $NH_4NO_3 \overset{250^\circ C.}{\longrightarrow} N_2O + 2H_2O$ (10 kcal/mol)
3. $2NH_4NO_3 \overset{> 300^\circ C.}{\longrightarrow} 2N_2 + 4H_2O + O_2$ (28 kcal/mol)
4. $3NH_4NO_3 + CH_2 \longrightarrow 3N_2 + 7H_2O + CO_2$ (82 kcal/mol)
5. $4NH_4NO_3 \overset{\triangle}{\longrightarrow} 2NO_2 + 8H_2O + 3N_2$ (27 kcal/mol)

Ammonium nitrate is very corrosive when it is wet and acts as a weak acid. It is also hygroscopic, and when the relative humidity is above 60 percent at ordinary temperatures it will slowly absorb enough water to dissolve itself. These factors should be taken into consideration in the design of mixing equipment and storage of open bags of AN.

Two of the most important criteria employed in appraising the performance of blasting agents is their detonation velocity and their sensitivity to detonation. Sensitivity corresponds in a somewhat parallel manner to the "pounds of trigger pull" in firearms, and detonation velocity, while not always truly indicative, gives one measure of the power of the explosive.

Crystal Phase Change and Sensitivity

The crystal phase transitions, particularly that occurring in a rise through 90° F, causes a physical rearrangement within the crystal which disrupts the crystal lattice and causes the particles of AN to swell. The temperature may fall back below 90° F and the physical rearrangement is reversed, but fractures have already been formed. Repeated recycling through the transition temperature results in a complete breakdown of the individual particles. Thus, an ammonium nitrate product which has been subject to such recycling may have an entirely different particle size distribution, and consequently different sensitivity and detonation characteristics than the original product. The curves in figure 1 show that the sensitivity of AN coated with diatomacious earth is markedly affected by temperature cycling, while that of an uncoated product is affected much less.[1]

Particle Density

In general the velocity of detonation increases almost linearly with the increase of bulk density of an explosive, and it would appear advisable to employ the most dense product available. However, an increase of particle density is accompanied by a decrease in oil absorption capacity and a decrease in sensitivity. Most dense products tested, including dense prills, Stengel Process products, Krys-

* *The authors are indebted to Monsanto Chemical Co. for their support of the explosives research program from which most of the data described herein are taken.*

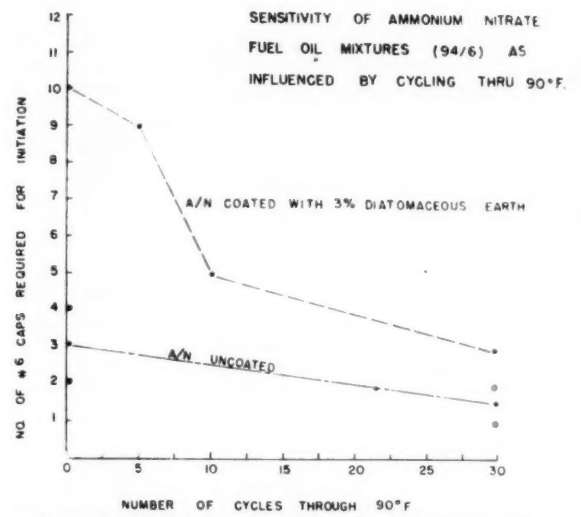

Fig. 1. The sensitivity of AN coated with diatomaceous earth is markedly affected by temperature cycling, while that of an uncoated product is affected much less

tal Process products and others, showed a marked decrease in sensitivity and detonation velocity as compared to porous prilled AN.

Particle Size

Particle size and particle size distribution have a marked effect on both sensitivity and detonation velocity. The larger the particles, the slower the mass rate of reaction, and the proper distribution of particle size will permit the highest bulk density. Hence, it would be expected that smaller particle size would result in increased sensitivity and detonation velocity, which is the case. Grinding of a portion of the AN does result in a more sensitive mixture and a higher detonation velocity.

Sensitivity Tests on AN-Fuel Oil Mixtures

Sensitivity can be defined as the ease by which an explosive can be made to detonate, but an exact definition is difficult to make in a chemical or thermodynamic sense. Currently ratings are based on various sensitivity tests which are designed to measure the explosive's sensitivity to detonation by shock, heat, electric spark, etc. Sensitivity is not only determined by the chemical nature of the explosive, but also by its physical state. Size, shape, and density of the particles, packing density, homogeneity of the mixture, charge mass, and confinement are a few of the more important physical properties. Sensitivity tests such as air-gap, impact and friction are unsuitable for AN-fuel oil mixtures. For insensitive AN blasting agents in use today, a minimum primer test has become the most widely used.

Sensitivity Measurements

The following tests have been adopted at the Missouri School of Mines.

Type 1. Confined Critical Diameter. Confined shots are made in steel pipe with a primer that is known to exceed the minimum booster requirements at the critical diameter. Charge diameters are varied as indicated from two to eight in. in one-in. increments, and in one-half in. increments from two in. to smaller diameters. The charge diameter is reduced until stable detonation no longer occurs. Charge lengths are a minimum of 24 in.

Type 2. Unconfined Critical Diameter. Unconfined shots are made in thin cardboard tubes or stove pipe at least 24 in. in length and charge diameter increments are the same as for the confined tests. The procedure is to use a high explosive primer of considerable size and to determine the smallest critical diameter that will support a stable detonation wave.

Type 3. Minimum Primer Unconfined. After the critical diameter is found, the size of the primer is reduced until the minimum booster for complete detonation is determined.

Type 4. Minimum Primer. Three-In. Diam. Confined Charge. This method is used in most of the sensitivity measurements. A charge diameter of three in. is approximately the minimum borehole diameter used in commercial open pit blasting and steel pipe offers confinement effectively equal to that of a borehole in rock. A charge length of 24 in. was found to be adequate because an unstable detonation wave seldom travels more than 12 in.

The selection of a standard series of primers was complicated by the wide range of sensitivity encountered. In three-in. steel pipe some mixtures are almost cap sensitive while others require from 20 to several hundred grams of high explosive for initiation. For very sensitive mixtures one or more number 6 strength electric blast-

Table I. Physical and chemical characteristic data for ammonium nitrate

Property	*Value*
Formula	NH_4NO_3
Formula Weight	80.05
Heat of Formation	87.27 kcal/mol (2070 Btu/lb)
Heat of Fusion	16.2 cal/gm (29.2 Btu/lb)
Heat of Solution	−6.3 kcal/mol (−142 Btu/lb)
Melting Point	169.6°C (337.3°F)
Decomposition Point	Not defined (Between 200–260°C)
Physical Form	White crystalline solid

Crystal Forms:

Process	*State* Initial → Final		*Temperature*
Transition	V	IV	−18°C (−0.4°F)
Transition	IV	III	32.1°C (89.8°F)
Transition	III	II	84.2°C (183.6°F)
Transition	II	I	125.2°C (257.4°F)
Fusion	I	liq.	169.6°C (337.3°F)

Density:

Form V	1.66 gm/cc (103.6 lb/ft³)
Form IV	1.73 gm/cc (107.5 lb/ft³)
Form III	1.65 gm/cc (103.0 lb/ft³)
Liquid	1.40 gm/cc

Solubility of ammonium nitrate in water and density of aqueous solutions:

Temperature °C	*Wt. % a/n in Water*	*Density of Solution*
0	54.5	
20	66.0	1.310
40	74.0	1.345
60	80.5	1.370
100	91.0	1.425

Ammonium nitrate is also soluble in ammonia, methanol, ethanol, acetic acid and aniline; slightly soluble in acetone, and ethyl acetate; insoluble in ethyl ether and both aliphatic (paraffins) and aromatic hydrocarbons.

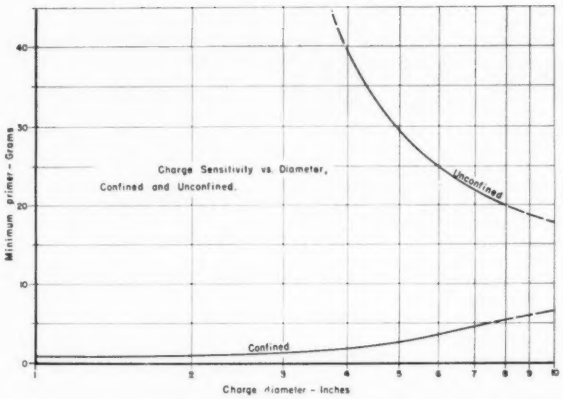

Fig. 2. Two possible factors which might account for the decrease in confined sensitivity are: (1) the ratio of primer to charge diameter increases, and (2) the distance that the shock wave from the primer must travel to be reflected from the steel wall of the pipe increases as the charge diameter increases

ing caps were used. The principle disadvantage in the use of blasting caps is that as the primer diameter increases, the length does not change with the number of caps used. With less than 15 caps the change in the primer to charge diameter ratio did not appear to have measurable effect upon initiation, while for larger primers consisting of more than 15 caps the primer to charge weight ratio was found to be more important and the maximum cap primer size was set at 25 caps. The reproducibility of sensitivity measurements below 15 caps was excellent but above 15 caps it decreased materially.

Data on Number 6 Strength Electric Blasting Cap	
Outside Diameter of Cap	0.275
Wall Thickness	0.0075
Diameter of PETN Base Charge	0.260
Weight of PETN Base Charge	0.300
Height of PETN Base Charge	0.299

The usual procedure in the determination of the minimum primer in three-in. steel pipe was to start with ten blasting caps. Distinguishing between a partial and complete detonation was difficult and the doubtful shots were listed as partial detonations. If ten caps produced a complete detonation, the number of caps was reduced in increments of one until shots on either side of the line separating complete and partial detonation were obtained. A sufficient number of shots was fired to find the primer size which produced a stable detonation wave 90 percent of the time. Should a mixture fail to detonate with ten caps, succeeding primer sizes were increased in increments of five caps up to the maximum of 25 caps. If a mixture failed with a primer of 25 caps, a high explosive primer was used with a constant length to diameter ratio (l/d) of one. The increment size changes of primer was as follows: 5 grams from 5 to 40 grams, 10 grams from 40 to 100 grams, and 50 grams from 100 grams to 300 grams.

Type 5. Minimum Primacord Sensitivity. In view of the fact that a considerable number of operators use Primacord as the initiator for AN-fuel oil mixtures, sensitivity measurements using Primacord as the sole initiator were included. Only a small number of sensitivity measurements were made with Primacord and no set standard procedures were adopted.

Purpose of Sensitivity Measurements

The evaluation of the confined and unconfined critical diameter and the minimum primer at the unconfined critical diameter are a relatively satisfactory means of expressing the sensitivity of blasting agents such as AN-fuel oil mixtures and for comparing the sensitivity levels of various types of AN-explosives and related slurry explosives. The measurement of sensitivity in a three-in. diam confined pipe was devised because other tests did not indicate the relatively small influence on sensitivity of such factors as oil content, age, density, etc. Primacord sensitivity tests were made to obtain sensitivity measurements more directly applicable to operations employing it as a primer. For a few tests combinations of methods were employed because some mixtures were sensitive to a single cap in a three-in. confined charge. The most convenient means of expressing the sensitivity in these cases is in terms of both the unconfined critical diameter and minimum primer at the critical diameter.

Table II. Variation of minimum primer with charge diameter and confinement

94% AN Uncoated Prills 6% Fuel Oil Density = 0.83

Steel pipe diameter (in.)	*Min. No. of No. 6 caps reqd. for complete detonation*	*Primacord full length of charge*
d_c 1½	3	—
2	3	—
3	4	150 grain
4	6	—
6	15	200 grain
8	15	—

Paper tubes unconfined diameter (in.)	*Min. amount of high explosive X reqd. for complete detonation Grams 1/d = 1**
d_c 4	40
6	25
8	20

** Length to diameter ratio of primer was kept constant. Same lot of AN was used for all tests. Length of charge was 2¼ in.*

Comparison Standards for Sensitivity Tests

Representative sensitivity measurements for a mixture 94/6 AN uncoated prills and No. 2 fuel oil are given in table 2. Some shots were made with Primacord in unconfined charges but they were markedly inconsistent.

The sensitivity values for unconfined charges are in general agreement with those reported by other investigators.[2] That is, the minimum primer for unconfined shots decreases as the charge diameter increases (figure 2.) The results, however, for confined shots have the opposite trend. The minimum primer values in table 2 represent 15 separate shots fired at the given diameter and therefore are not considered abnormal. Two possible factors which might account for the decrease in confined sensitivity are: (1) The ratio of primer to charge diameter increases, and (2) the distance that the shock wave from the primer must travel to be reflected from steel wall increases as the charge diameter increases. Both curves appear to be asymptotic to a horizontal line of about 17 caps, which would indicate that this number of caps would be required to detonate an infinite mass of blasting agent.

Since some physical properties of AN-fuel oil mixtures change easily with environment which in turn affects the sensitivity measurements, two standards were adopted for sensitivity measurements of all mixtures:

(1) Representative charge density is the pouring density in a six-in. pipe.

(2) Blasting agents are mixed in a concrete mixer to insure maximum homogeneity.

To insure reasonable standardization of sensitivity tests for AN-fuel oil mixtures, the effects of manner of mixing and age of the compounded mixture were studied. A summary of the results obtained for five different kinds of mixtures is given in table 3, and figure 3. It was found that sensitivity increases as the prill-oil mixture ages, and that after aging two hours all the mixtures seem to approach their maximum sensitivity, except "E-2" RCP and "E-2" ground. It could be expected that these mixtures would require a longer soaking time because of the very non-porous nature of the prills.

"E-2" is a trademark name designation for dense, stabilized, ammonium nitrate prills manufactured specifically for the fertilizer industry. These prills are not recommended for blasting purposes. Their bulk density is 62 lb per cu ft, while that of regular fertilizer grade AN prills is 47 lb per cu ft. The difference in pouring density is also quite pronounced, 0.83 grams per cubic centimeter for a 94/6 mixture with fertilizer grade prills and 1.00 gram per cubic centimeter for 94/6 mixture with "E-2" prills. "E-2" RCP is the undersized screened product from the manufacture of "E-2" prills (minus 20 mesh), "E-2" flaked material is "E-2" melted and cast into a thin sheet and then broken, and "E-2" ground refers to the material obtained when "E-2" prills are ground in a hammer mill.

Comparison between the values given for the last two mixtures in table 3 should take into account the difference in bulk density and particle size. "E-2" RCP holds about two percent fuel oil, all essentially adsorbed by the prills, and prolonged soaking is required before it can be detonated. "E-2" ground material readily holds six percent fuel oil, most of which is also adsorbed by the AN particles. Its high detonation velocity and sensitivity are largely due to the smaller average particle size and relatively homogeneous composition. The increase in sensitivity with age was expected because the particles are relatively non-porous and a finite time is required for the oil to penetrate the grains.

Detonation velocity measurements showed that a well mixed product will approach maximum velocity within a short time after mixing. The comparison between detonation velocities obtained from blasting agents mixed by the two usual field methods, that is (1) pouring the oil in the top of an open bag or (2) mixing the prills and oil in a positive mixer, indicates a loss of explosive energy when the mixture is not thoroughly mixed. Equal velocities exhibited by the prills with two percent clay coating for different soaking times has not been satisfactorily explained. However, the importance of obtaining a uniform prill-oil mixture can not be minimized. It not only allows the utilization of a larger percentage of the maximum energy available, but also decreases the chances of partial detonations.

Table III. Influence of age on detonation velocity and sensitivity

Mixture	*Oil poured on top of bag*[1]	*Mixed 5 minutes in concrete mixer*			
		Aged 5 min.	*Aged 2 hr.*	*Aged 24 hr.*	*Aged 7 days*
94% AN unc. prills 6% Fuel oil Den. = 0.83	— 10900[3]	5[2] 11700	4 11700	3 11700	3 –
94% AN prills w/0.4% DE 6% Fuel oil Den. = 0.83	— 10500	6 11300	— 4	— 4 11650	— 4
94% AN prills w/2.0% DE 6% Fuel oil Den. = 0.83	— 11350	15 11350	15 —	15 11750	10 —
94% ("E-2")* RCP 6% Fuel oil Den. = 1.05	— No. Det.	Failed at 35	— —	— —	15 10000
94% ("E-2")* ground 6% Fuel oil Den. = 0.81	— —	— —	2" Dia.[4] 13500[5]	1¼" Dia. 13500	1" Dia. 13500

(1) Aged 20 minutes.
(2) Minimum number of No. 6 caps required for complete detonation.
(3) Detonation velocity, fps, primer 60 percent ammonium dynamite.
(4) Unconfined critical diameter, primer 1 No. 6 cap.
(5) Detonation velocity, fps, three-in. diam steel pipe.
** Trademark name for dense, stabilized ammonium nitrate.*

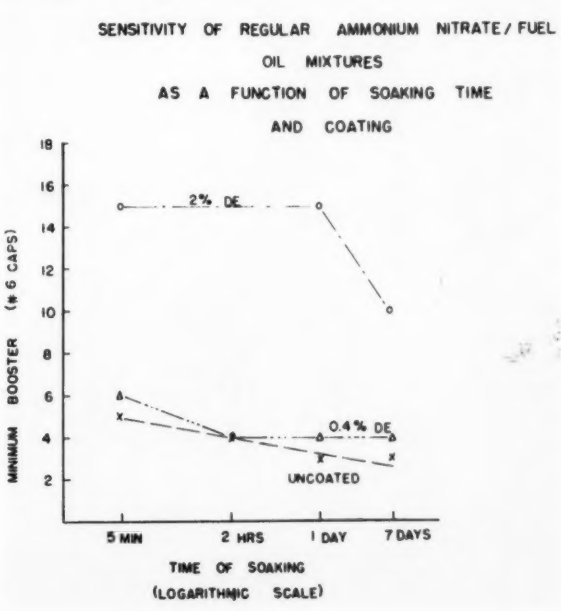

Fig. 3. Sensitivity increases as the prill-oil mixture ages

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The final portion of this report will appear in the December issue of Mining Congress Journal.

Mechanized Raising

A new track climbing drill platform has proven itself with completion of only three raises

DRIVING raises at the Iron King Branch of Shattuck Denn Mining Corp., Humboldt, Ariz., is faster and more economical since the company installed an Alimak raise climber at its operation there.

In order to fully understand the advantages of the raise climber, it is necessary to describe the basic machine, a complete cycle of a raise round, and the speed and economy resulting from use of this new method of raise driving.

The raise climber consists of a drilling platform that is raised and lowered by a 6.2 hp compressed air motor driving, through double roller chain and sprockets, three worm gears connected in series. These worm gears drive pinions which grip the guide rail rack. The worm gears are fitted with spring-loaded couplings so that a small rock or grit in the rack is passed over without disturbing the mesh between the rack and the other pinions.

The rack, which is incorporated into the right side of the guide rail (figure 1) just behind the front steel plate, consists of 19 mm diam pins set 27 pins to the meter. Between each pin, a hole is cut in the front plate to facilitate cleaning.

Climber Operated from Cage

Standard guide rail is made up of four 1¼-in. diam steel pipes banded to the front steel plate and to rear anchor brackets, and weighs 27 lb per ft. The four pipes are grooved at the end plates, and "O" ring seals are placed between the sections for sealing the pipe connections.

The guide rail forms a track which, when rock-bolted to the raise wall, provides a means for lifting the drilling platform to the desired height.

The support structure for the drilling platform consists of a heavy steel frame with four sets of guide rollers that fit around the front section of the guide rail track. From the top of this vertical structure, a drilling platform is hinged and supported by two adjustable legs which can be set so the platform is level regardless of the angle of the guide rail track (figure 2). The track angle can be set from vertical to 55°.

A man cage, that is attached below the platform accommodates two men. It is entirely enclosed with wire mesh, and has a gate door on the side. This is the operating center for raising and lowering the device, and as such contains the operating handle and safety brakes. During the raising and lowering operation, the heavy drilling platform provides excellent overhead protection for the miners. A hinged "trap door" directly above the cage gives access to the drilling platform.

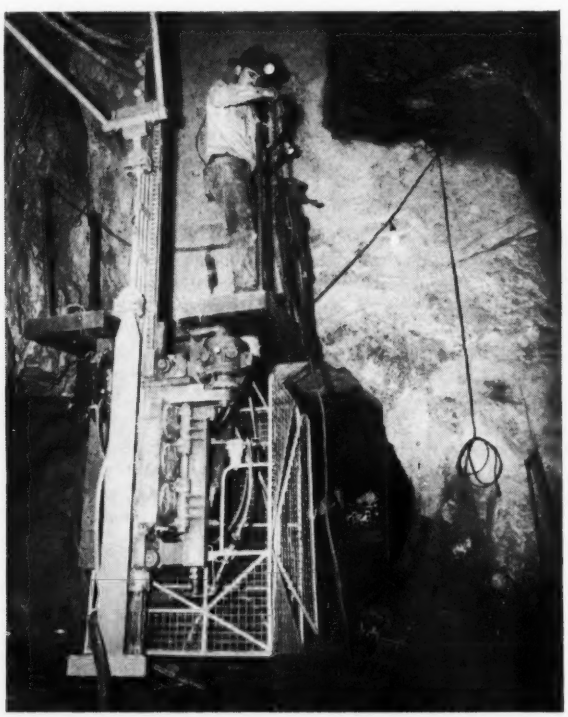

Fig. 1. The raise climber is essentially a track climbing drill platform powered by a 6.2 hp compressed air motor

Company Modified Oiling System

Located in the cage compartment is the air and water manifold with connections for the drilling machines and for the supply. Oilers are incorporated into the manifold and feed oil to the raising and lowering air motor or to the air drills. The oilers are filled through a small hose each shift, or oftener, from a ten-gal reservoir that actually is a hollow section within the drilling platform.

It should be noted that one of the main modifications made to the machine by the Iron King shops was the rearrangement of the oiling system. The miners were not familiar with the Swedish oilers and did not find them easy to adjust, so a large oil reservoir was placed in the center of

at the Iron King Mine

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the manifold, balanced with air pressure, and oil fed through oil feeding valves to all machine connections. This arrangement has been very satisfactory.

Although Alimaks now being delivered in the United States are equipped with Standard U. S. pipe thread nipples and couplings, the Iron King's first machine was supplied with Swedish straight threaded pipe connections that require wicking. Because of this, all nipples and couplings were changed to those with Standard American tapered pipe threads.

One other basic construction feature of the drilling platform should be noted: the outer two ft is a hinged section that can be raised during barring down of the back to allow material to pass the platform and fall to the bottom of the raise.

Safety Features Include Two Sets of Brakes

The machine originally had a spring-loaded disc brake that operated on the drive sprocket between the air motor and worm gear housing. This equipment has since been replaced with a modification kit that contains a drum brake of larger braking capacity and more positive action. On the side of the main frame a safety brake, consisting of a spring-loaded eccentric, operates directly on the guide rail. These two brakes will hold the machine for all normal operations, but as an added safety feature, and for strength, a hook and chain is supplied that attaches to the guide rail and to the platform, and is placed and set during drilling.

Other auxiliary safety features include a reel of bell wire for lowering messages or pulling up small spare parts, two sets of climbing shoes and safety clamps for climbing up or down the guide rail in cases of emergency, a small steel protective hood that can be placed in various positions on the platform over the head of a man scaling down the back, posts and chains that can be placed around the platform (figure 3), and an air-powered floodlight. This floodlight, which is mounted in the drilling platform, is very susceptible to breakage and is the only faulty design feature found in the machine. A small rock from the back put it out of operation during the first drilling shift, and no further attempt was made to keep it functioning. If the light was portable and could be hooked to the guide rail at a convenient height and moved about at the miners' discretion, it would be more valuable.

Erecting the Climber at Raise Site

The guide rail described earlier was the standard section. Two special sections are necessary to operate the machine by the Alimak method of raise driving: a hinged section of track that has inlet pipe connections to the four pipes that form part of the guide rail, and an extra heavy rail section that has four rear anchor brackets instead of the usual one.

Three auxiliary pieces of equipment used to complete the raise method will be described as their function becomes clear.

Initially, certain space requirements and preliminary work must be done at the raise site. For a six by six-ft raise, a compartment 10 ft wide, 20 ft long, and 12 to 13 ft high must be shot out, and at one corner the raise must be driven ten ft above the back. With the area cleaned out,

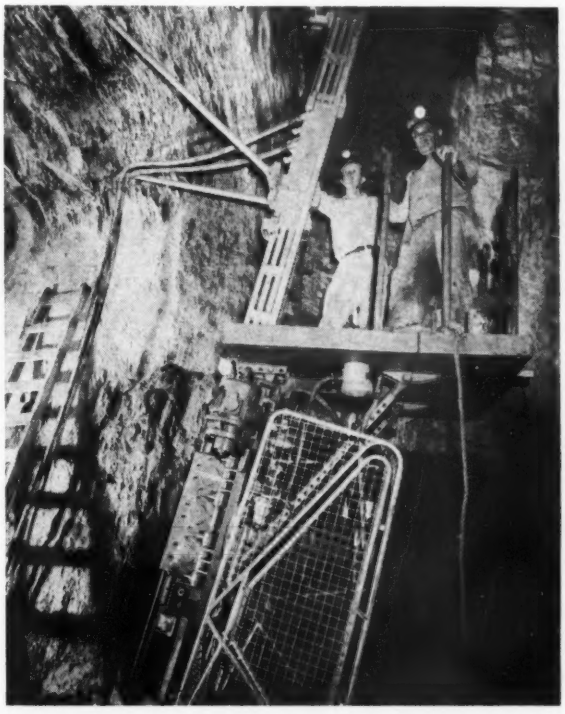

Fig. 2. Two adjustable legs can be set so that the drilling platform is level regardless of the angle of the guide track

Fig. 3. Posts and safety chains on the platform help make it a safer place to work

the raise climber is ready for installation.

An erecting base is built up by bolting three sections of guide rail into a special bracket forming a "T." The climber is brought in on its guide rail section, laid with the guide rail section down, and blocked up about one ft above the floor. The center of the "T" erecting base with its special bracket is attached to the bottom of the guide rail that contains the climber. The long end of the "T" erecting base is raised until it is standing vertical and the final bolts of the special bracket are attached to the guide rail. Now, with about four good men pulling down on the long end of the "T," the base becomes horizontal and the climber and its guide rail become vertical and are supported by the base.

Special wheels are supplied that fit in the outer end of the erecting base "T," if it is desired to move the upright climber any distance. At the Iron King, the wheels are not used, as the erecting base is placed on lagging and the climber, when erected, is within a few inches of its desired location. Any minor adjustment is done with a bar. The climber is adjusted for position and is tilted for inclination by adjusting bolts in the special erecting bracket.

Guide Rail Bolted to Raise Wall

Using the climber platform, sections of guide rail are bolted on, with the special hinged section of guide rail positioned approximately two ft below the back of the large compartment. The special heavy duty rail section is placed on top of the hinged section and the machine is run up to the desired height to bolt this section to the raise wall with eight bolts. The type of bolt assembly used consists of a cone bolt inside an expansion pipe, a nut, washer, and a U washer. After drilling the hole, the bolt with nut, washer and expansion pipe is placed through the anchor bracket of the guide rail until the threads are seen behind the bracket. The bolt is set by placing the U washer over the threads behind the bracket, and with the hook of a ratchet wrench the nut is jerked out. The nut can then be tightened without deflecting the anchor bracket, thus the guide rail stays in alignment.

With the guide rail bolted to the raise wall, the climber is run down and the erecting base dismantled.

To operate the climber, an air supply to the air motor is needed, and one of the auxiliary pieces of equipment supplied is a 0.6 hp, air-motor-driven hose reel which has a capacity of 600 ft of hose. The hose plays out under a control arm that is raised up as hose is pulled from the reel and the reel is in neutral. When the hose slacks off, the control arm lowers and the air motor begins to wind up the hose (figure 4). This hose reel is placed in the compartment on the wall farthest from the raise. The climber can now be run to any height.

A special air and water remote control manifold is mounted in a safe place near the hose reel in the base compartment. A supply of air and water is hooked to the manifold and hoses are run to the guide rail inlet connections just above the hinge.

A complete raise round has the following sequence: Starting with a round blasted on the previous shift, the position of guide rail is some ten ft below the blasted back, and has a heavy blasting plate bolted to the top. This plate has a series of drilled holes in it.

The miner first cleans up the blasted round, by mucking machine, or in the

Fig. 4. One of the auxiliary pieces of equipment, a 600 ft capacity hose reel (background), automatically pays out or takes up hose as required. The tugger in foreground is for swinging climber out of raise. Note remote control manifold at right

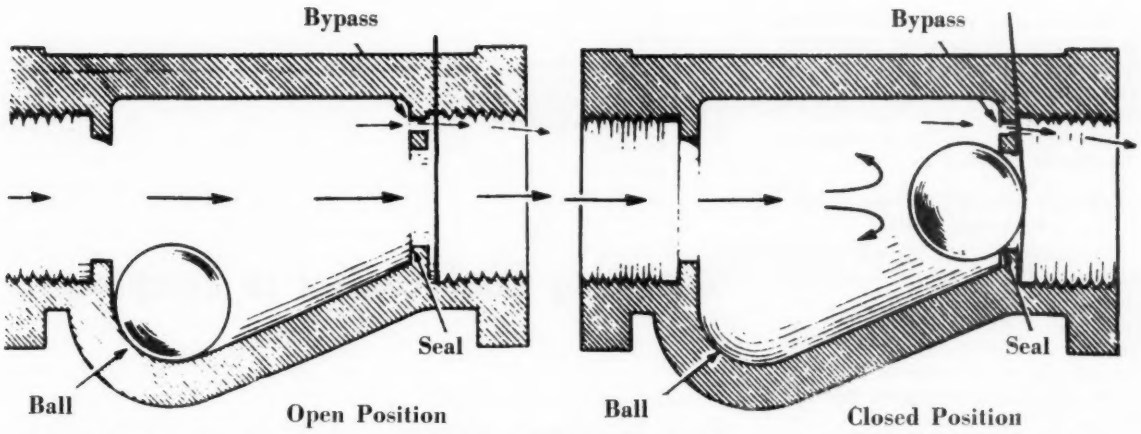

Fig. 5. Automatic valve in remote control manifold. The ball is at rest (left) after water pressure in pipe system is equalized or when shut-off valve is closed. When the shut-off valve is opened rapidly, the ball shuts off the supply (right) except for the small amount going through the bypass

case of the Iron King operation, by slushing the muck up an inclined ramp into cars. He then turns on the air and water at the remote control manifold, and air and water is sprayed through the top blasting plate, thoroughly washing down and ventilating the raise.

Ball Valve is Heart of Remote Control Manifold

The men lower the climber from its safe position and run it up the raise so that they can bar down the back and determine the length of guide rail needed. They then run the machine down the track and load the proper length of guide rail onto it. A rail clamp placed on the new section of guide rail fits into a lifting pipe boot that keeps the new section parallel to the track.

The climber is run up to the top of the guide rail and positioned with the bottom of the new rail section just above the top of the track. The blasting plate is removed and the new section of rail is rotated 180° in the pipe boot, thus bringing it directly over the guide rail track. The climber is lowered and the new section bolted into place. Now the climber is run up the new section and, using a jackleg, holes are drilled through the anchor bracket and rock bolts placed and tightened. The climber is then run to the bottom of the raise, where the water and air are turned on at the base remote control manifold.

The valve in the remote control manifold is shown in figure 5. When the shutoff valve is opened rapidly, the ball rolls up the incline and shuts off the air or water supply except for a small amount going through a bypass. When either the water or air is turned on, the valve shuts off the water or air up the guide rail as the top is open.

Now the climber is run up with the stopers loaded on the drilling platform. A plate with valves and hose connections is placed on the top of the guide rail and bolted down. The valves are left open until the plate is secure and then turned off. The small amount of air and water coming through the bypass now builds up pressure against the closed valve at the top of the guide rail. When the pressure is equalized, the ball in the remote control manifold rolls down the incline and the valve at the top of the guide rail can be turned on slowly without disturbing it, and a full supply of air or water will now flow to the drilling machine manifold in the climber.

Climber Will Lift 1100-lb Load

After the round is drilled out, the hoses are unhooked, and when the valves on top of the guide rails are opened quickly, the ball shut-off valve at the remote control manifold cuts off the flow of air and water, and the blasting plate is installed. The climber is now run to the bottom of the raise, the shut-off valves turned off, and the climber is unloaded and then loaded with powder. The climber is run up, the holes charged, and the round wired, and then the lead wire is played out while the climber is lowered. A small tugger hoist with cable run through a sheave in the roof of the large compartment is hooked to the bottom of the guide rail and the machine is pulled up under the brow, after which the round is fired electrically (figure 6).

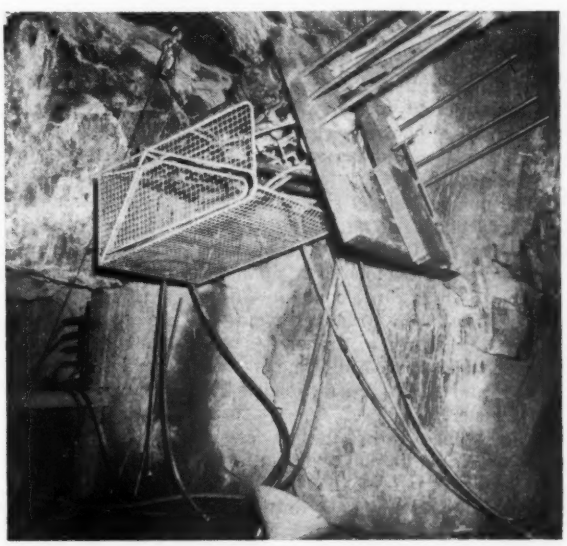

Fig. 6. The climber is swung up under the brow of the raise during blasting

The climbing speed of the Alimak is 40 fpm and the lowering speed is 60 fpm. It will lift a load of 1100 lb. The largest piece, when dismantled, is four ft ten in. by two ft seven in. by one ft three in., and the complete weight of the climber is 1500 lb.

Raises Completed 2.4 Times Faster With New Method

An appraisal of the Alimak method can best be made by tabulating and comparing results against the previous raise method. The Iron King Branch of Shattuck Denn has been driving three-compartment timbered raises with center manways and two chutes for 14 years. However, for the purpose of this article, the 1959–60 average of nine raises is compared to three raises driven by the Alimak method below.

	Average 9 Raises (Timbered)	Average 3 Raises (Alimak)
Number of men in raise crew	2	2
No. of eight hr shifts worked per 24 hr	1	1
Tramming crewshifts used to haul muck	½	0
Bonus contract shifts per raise	67	43
Company time shifts per raise	31	16
Shifts lost ventilating raise	22	0
Height of raise	142 ft	142 ft
Cost of timber per raise	$1200	0
Man shifts required to strip a waste raise	48*	0
Total working days from beginning to end of raise	87	36

** Ore transfer and gob transfer raises are driven in waste, and all timber must be stripped out.*

It is quite obvious that many savings have resulted. For example, the tramming crew formerly needed to pull the raise chutes is eliminated, as the Alimak crew handles their own tramming.

The bonus contract shifts required to complete a raise under the Alimak method is 64 percent of the shifts necessary to complete a timbered raise. In addition, company time shifts have been practically cut in half, $1200 worth of timber is saved in each raise, ventilating time is eliminated, and raises are completed 2.4 times faster.

The Alimak raise climber, essentially a track climbing drill platform, has proven itself at the Iron King with the completion of only three raises.

Roof Control*

Matching Roof Control to Equipment

With mining methods and techniques changing almost daily, the problem of roof support becomes an even greater challenge than it was in the days of hand loading. Mechanized mining methods, for example, demand a system of support that will provide flexibility and unhindered movement of machinery. Thus, it becomes necessary to set up a definite system of roof support for a particular mine that will meet the requirements of the type of mining equipment being used, and also the requirements of the roof structure encountered.

Careful study by both management and inspection agencies is necessary to arrive at the best method of control. Once a system has been thoroughly studied and adopted, it is necessary that the employes of the mine carry out the plan faithfully.

Eliminating falls of roof begins with the first planning by the engineers. It is their job to tailor the mine to suit the requirements of the machinery to be used, or to design machinery that will fit the requirements of the mine. In other words, just any type of machinery for any mine won't do. Often it is necessary to change the mining system, after operations have started, to meet safety requirements. Once the right machinery and the proper system of mining are fitted together, they must be followed by an effective method of roof control.

To begin with, a careful study of the nature of the mine roof is important. It is necessary to define just what the roof support problem is, and then to develop a system that will afford maximum protection for workmen. For example, the system should provide for as much side and overhead clearance as is safe so that the likelihood of dislodging roof supports with machinery will be reduced to a minimum.

Roof control may be obtained by several methods—by use of straight-post timbering, the use of posts with collars, and by the comparatively recent development of roof bolting with several adaptations. In mines where fixed equipment, such as chain and shaking conveyors are used, the conventional roof support methods may be used with a fair degree of success, but it may be necessary to modify these methods with steel roof jacks and bolting. Where mobile equipment is used, it is a "must" to choose a system that will provide maneuverability combined with safety.

The roof bolting method seems to provide the best support in a situation where mobile equipment is to be used, since timber legs can be eliminated. However, the bolting method can be used only in mines where the structure of the roof lends itself to this method of control. The roof must be capable of forming itself into a "beam" when held together by the bolts. In many cases where the immediate roof has a tendency to spall, it has been found necessary to use cross-collars together with the bolts.

Care should be taken to avoid common errors in the use of roof bolting, such as not using bolts on proper centers, and considering the use of bolts a license to drive places wider than specified. Experience has shown these practices to be basic causes of roof falls.

In addition to a systematic method of timbering, other essentials for proper mine roof support are regulations, diagrams, and detailed instructions showing how and where to set timbers or bolts; adequate supervision; and good discipline. These must be supplemented by the determination of everyone on the job to make the roof support program succeed. The goal of preventing roof fall accidents cannot be achieved unless proper attitudes toward the program are developed. The persons involved must believe in the program, and want it to succeed.

** Prepared by the Advisory Committee 1960 National Campaign to Prevent Injuries from Roof Falls in Coal Mines.*

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Some economic aspects of coal preparation

The coal industry has continually increased its efforts to market cleaner coal, and to deliver to its customers a product of ever-increasing dollar value per ton. Result—today over 20 percent of all raw coal mined is discarded at the mine as reject, and about 65 percent of all raw coal mined is shipped as mechanically cleaned coal

MUCH has been written on the subject of coal preparation economics by those more eminent in their profession than the writer, and much of the text of this article will be the thoughts and work of others. The importance of the subject warrants repetition of past thoughts and the introduction of whatever additional information may appear herein.

Profits from the operation of a coal mine may be increased by either decreasing production costs or by increasing realization. Since preparation is the final production step before the finished product is loaded for shipment, it is therefore the only production step that can make up for cost shortcomings in mining and haulage, or that can, by its accomplishments, raise the value of the product to command the highest possible realization.

By the same reasoning, preparation of the raw coal can be so costly from a material handling standpoint that previous mining cost advantages are lost. Or, if correct market analyses have not been made. the costs of preparation may not be realized in increased sales price, and mining cost advantages may be lost.

Also, while increased scope of preparation will quite often enable slipping market outlets to be retained, there have been many instances where market outlets were lost in spite of added preparation practices.

Certainly then, it is of utmost importance that a very careful analysis be made of present and intended preparation policies if anticipated economic benefits are to be realized.

Mechanization Leads to Increased Preparation

Probably more mines have adopted mechanical preparation facilities in order to permit the underground transition from hand loading to mechanical loading than for any other reason. The necessity for increased productivity at the face has been brought about by continually increasing labor costs.

During the ten year period between 1948 and 1958, the average hourly labor rate increased about 62 percent. These increased costs were generally offset by an increase in productivity (tons per man shift) during the same period of about 81 percent. Since supply and overhead costs also showed a steady increase, mechanization and greater productivity was the only way for most mines to survive.

In addition to increasing productivity, the coal industry "held the line" on prices to the extent that average price f.o.b. the mine during the same ten year period at no time equalled or exceeded the 1948 price (figure 1).

This increased productivity thru underground mechanization has generally resulted in raw coals with considerably more impurities than with hand loading. In addition, the percentage of finer sizes and the impurities in the finer sizes have increased with the advent of mechanical loading. Addition of, or increase of mechanical preparation equipment has usually resulted from mechanization and generally, most mines have enjoyed economic benefits by making large decreases in mining costs with only nominal increases in preparation costs.

In 1937 about 73 percent of all bituminous coal produced was loaded by hand underground (figure 2[a]). The remaining 27 percent or about 113,000,000 tons was loaded mechanically underground or by strip mining.

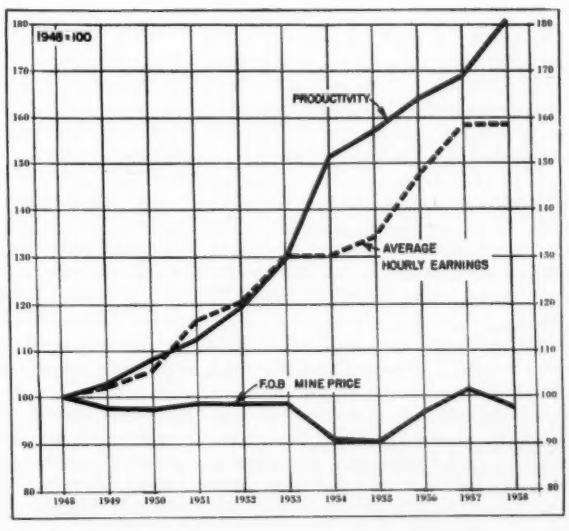


Fig. 1. Relationship between mine price of coal, wage rates, and productivity, 1948–1958. (Courtesy National Coal Policy Conference, Inc.)

In 1957, only about 11 percent of all production was hand loaded and the tonnage loaded mechanically underground or stripped was about 438,000,000 tons or about 89 percent of the total.

Coal mechanically cleaned in 1937 totaled about 62,000,000 tons or about 14.8 percent of the yearly total and about 55 percent of that mechanically loaded or stripped. In 1957, about 304,000,000 tons were mechanically cleaned. This 304,000,000 tons represented about 61.7 percent of the total yearly production and about 70 percent of that mechanically loaded or stripped.

Increased preparation then was a necessary adjunct to the curtailing of hand loading and the increase in mechanical production. This trend will continue as more and more hand mines convert to mechanized equipment or cease operation.

Freight Cost—Its Effect on Producer, Consumer

As in any other business where a finished product is sold on a competitive market to ultimate users, the coal producer must offer a coal at a price/quality level that will permit his product to survive against competition. Because coal is normally sold f.o.b the mine, the consumer must bear the freight cost and his measuring stick as to price is the total of purchase price plus freight.

This fact can make it impossible for a producer to put his product into certain areas regardless of the quality and price f.o.b. at the mine. It might be said, then, that a coal producer not only must compete with other operators as to costs and quality, but must also suffer or gain from a comparison of freight rates. In achieving costs and quality, an operator has the opportunity to put his operating abilities and financial position in competition with his fellow operators, but when it comes to the freight question, he is generally at the mercy of a situation beyond his normal control.

It is of some interest to note that while the selling price of bituminous coal f.o.b. the mine showed a decrease of about 2.6 percent during the period 1948–1958, the rail freight cost per ton mile increased about 20 percent.

All indications are that freight rates are being lowered and will tend to decline somewhat. However, when it is considered that freight cost equals f.o.b. mine price on about one third of all bituminous coal shipped, the consumer cost of hauling impurities is of vital importance and increased efforts will be made to purchase better and better quality coals.

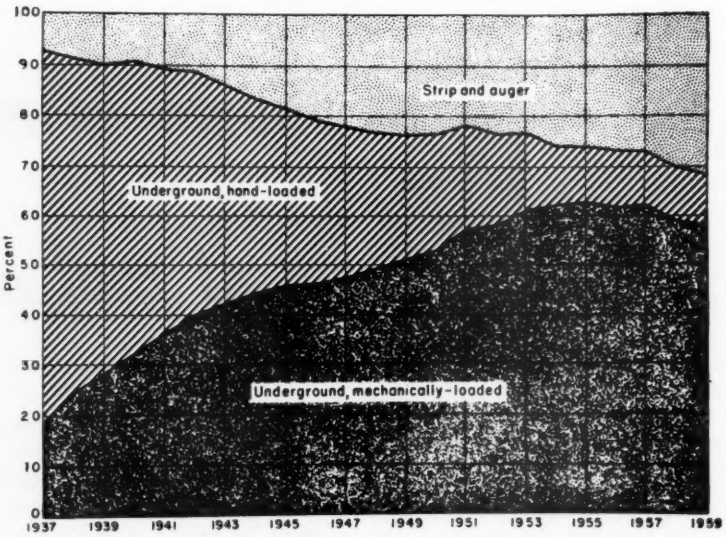


Fig. 2. In 1937 about 73 percent of all bituminous coal produced was loaded by hand underground, while in 1957 only 11 percent of all production was hand-loaded. Increased preparation was a necessary adjunct of this mechanization trend

U.S. Bituminous and Lignite Production, By Methods of Mining and Cleaning, 1957–59

	1957		1958		1959*	
	Thousand Net Tons	Percent	Thousand Net Tons	Percent	Thousand Net Tons	Percent
Hand-loaded underground	54,912	11.1	43,311	10.6	40,000	9.8
Mechanically loaded underground	305,737	62.1	243,573	59.3	239,000	58.3
Mined at auger mines	7,946	1.6	7,320	1.8	8,000	1.9
Mined by stripping	124,109	25.2	116,242	28.3	123,000	30.0
Total production	492,704	100.0	410,446	100.0	410,000	100.0
Mechanically cleaned	304,027	61.7	259,035	63.1	260,000	63.4

* *Preliminary.*

Utilities Are Principal Consumers of Coal

Coal is the basic fuel and source of energy for many varied markets. Generally these markets (figure 3) are divided into five groups: electric utilities; coking coal; industrial steam, including railroad fuel; retail, and export.

Electric utilities are consuming almost 40 percent of this year's bituminous production and if several estimates are correct, will consume nearly 50 percent of the production ten years hence. Since electric utilities are the principal consumers of today's coal and since about two-thirds of the country's steam-electric power is generated by coal, this article will confine the major portion of its text generally to the economic factors involved in preparing coal for market in that industry.

For the most part, coal producers, when talking about the "economics of coal preparation," are prone to consider only such items as comparison of costs of preparation methods and practices at their preparation plants. They often forget that the customer also must consider "preparation economics" in comparing his handling and usage costs for coals of various qualities. Both producer and consumer have intense interest in costs of coal preparation; both must pay for improving coal above its "raw as mined" quality.

Coal Properties That Affect Combustion

Let us examine some of the problems of the electric utility industry that are related to the quality of the coals they burn and thus to coal preparation.

Coal burning steam generating plants employ various combustion techniques. Each type of burning

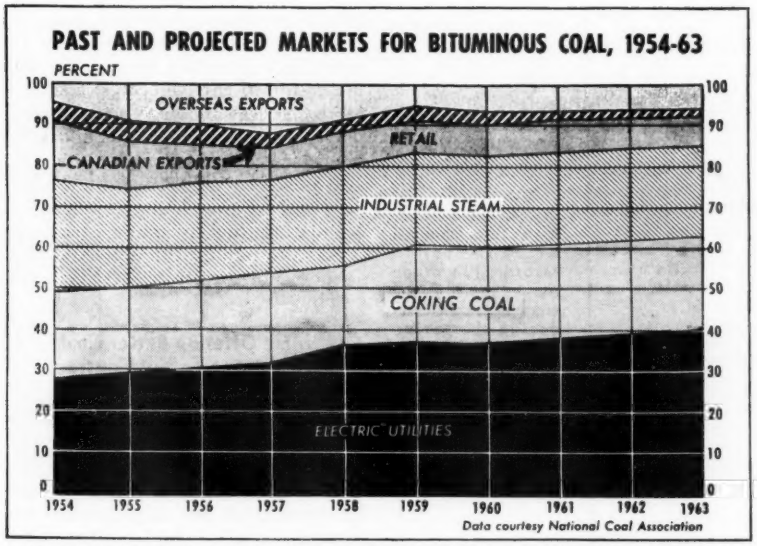


Fig. 3. Coal is the basic fuel and source of energy for many varied markets. Note that the electric utilities are consuming almost 40 percent of this year's bituminous coal production. It is estimated that they will require neraly 50 percent of the production by 1970

equipment has its own characteristics and for the most part, has been designed into plants in a given area in accordance with the types of coals known to be most economically available at the time of plant construction. The caking or free burning characteristics of coals have the most influence on the selection of the coal burning equipment.

Table I[b] shows the relative importance of various properties of coal as they affect combustion. This chart should be used only as a general "rule of thumb" rather than as a guide for any existing plant, and is presented herein only to emphasize the relative unimportance of ash and calorific value on combustion performance in the various burning techniques, and to indicate the relative importance of each coal characteristic in the over-all picture of a given combustion technique.

It should be noted that the only important characteristic controllable by the producer is size consist and, in one case, moisture content. Caking index and ash fusibility are quite important but are inherent in the seam rather than brought about by preparation practices. It must be kept in mind, however, that the above applies only to the combustion performance of the coal in the burning device and does not apply to its over-all usage in the plant.

The majority of coal burned as boiler fuel in the generation of electric power is consumed in pulverized fuel equipment. The newer plants built in the past 15 years are much more flexible than older plants, and the coincidence of their erection with a falling price situation and an oversupply situation in the coal industry led to a general feeling that these plants could burn coals of most any quality, and the cheapest (and dirtiest) fuels were used.

The error of this thinking became more and more apparent as power plant operators began noting and emphasizing the added operational and maintenance costs attributed to purchasing policies where delivered Btu was the only criterion.

Much has been written and said about the costs of burning poorer quality coals, and each plant must be regarded individually.

Wide Variation in Moisture Can Cause Considerable Trouble

Let us look at the coal characteristics controllable by the coal producers; moisture, sizing, ash, and sulphur:

(1) Excess moisture will plug downspouts and limit pulverizer capacity. Mill capacity is reported to drop to 60 percent when moisture increases from five to eight percent in one instance, and in another, it is estimated that, for each percent of moisture above four or five,

COAL PROPERTIES SIGNIFICANCE CHART FOR COMBUSTION PERFORMANCE

	Stokers					
	S.R.	M.R.	T.G.	S.S.	P.F.	Cyclone
1. Size consist (as fired)	V	I	I	V	V[1]	V
2. Moisture[2]	M	M	N	M	V	M
3. Caking Index[3]	I	I	V	M	N	N
4. Ash Fusibility	I	I	M	M	I	V
5. Grindability	N	N	N	N	V	N
6. Friability	M	M	M	M	N	N
7. Volatile Matter	M	M	M	M	I	M
8. Fixed Carbon	N	N	N	N	M	N
9. Ash Content	M	M	M	M	M	M
10. Calorific Value	N	N	N	N	N	N
11. Ash Viscosity	M	M	M	M	I	V
12. Ash Composition	—See Footnote 4—					
13. Sulphur	—See Footnote 5—					

Rating Code: V Very important; I Important; M Minor importance; N Little or no importance

Footnotes:

[1] Degree of fineness is a better term for P.F.

[2] Surface moisture is more critical than inherent moisture. Moisture is very important from the standpoint of plant flowability.

[3] Some engineers are attempting to use the F.S.I. as an index of the degree of caking.

[4] Ash composition is very important as it affects fireside fowling, but not important to combustion.

[5] Sulphur is important from a corrosive standpoint, but not important to combustion.

Table I. Coal burning steam generating plants employ various combustion techniques. Each type of burning equipment has its own characteristics, and the caking or free burning characteristics of coals have the most influence on the selection of equipment. Stoker types referred to in the table are as follows: S.R., single retort; M.R., multiple retort; T.G., traveling grate; S.S., single spreader, and P.F., pulverized fuel

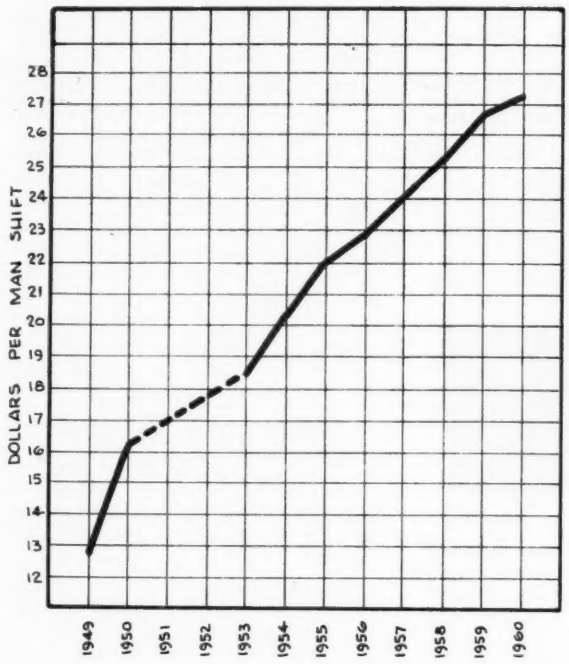


Fig. 4. Based on information obtained from mine payroll records, the graph shows the rise in average man shift costs during the period 1949 to 1960 for two mines. This trend will apply generally to outside labor costs in the industry

the plant capacity drops about 1000 kw. Also, moisture content affects the selection and operation of the air heater since part of the air from this unit is used to dry coal in the pulverizer. Similarly, the forced draft fan output is dependent on fuel moisture content. Wide variation in moisture then can cause considerable trouble in plant operation.

(2) Sizing of the fuel is not of extreme importance, but too coarse coal will plug feeders and, to some extent, affect pulverizer capacity.

(3) Ash content of the fuel directly affects the heat value and thus, along with the moisture, dictates the capacity required in any given unit. Ash composition dictates the temperature of the gas leaving the furnace which in turn generally predicates installation, operating, and maintenance costs of furnaces, superheaters, reheaters, soot-blowers, air heaters, induced draft fans and dust collectors. A low grade coal will dictate not only a large furnace but a large superheater and reheater. Ash percentage and ash fusion temperature are the major factors in determining the required soot-blowers. High ash coal may cause plugging of heating surfaces in air heaters and ash percentage and composition govern the wear on induced draft fans. Since about 80 percent of the ash is carried out with the gas, it is obvious that reduction in dust collection costs can be brought about only by lowering the quantity of ash in the coal.

(4) Sulphur content of a fuel influences the installation, operating, and maintenance costs of downspouts, pulverizers, furnace, soot-blowers, air heaters, dust collectors, and induced draft fans. Corrosive effects of sulphur are felt in downspouts, feeders, hoppers, air heaters, induced draft fans, and dust collectors. Since a large percentage of sulphur in coal is in the form of pyrites, much of this material is thrown out through pulverizer trampiron spouts and in many cases must be removed manually. Generally, high sulphur content means high iron content and this causes ash deposit problems in the furnace. Since most utility companies exit gas temperatures fall near or below the dew point, acid corrosion is quite high in air heaters with high sulphur fuels; this point and the need for reducing sulphur fumes discharged to atmosphere head up the reasons for utilities wanting lower sulphur coals.

Burning Inferior Grade Coals Ups Incremental Costs

Studies by others[c] of a great number of plants indicate that the increased incremental costs due to the burning of inferior grade coals can be generally summarized as follows:

	$ Cost Per Ton
Power replacement and fixed charges*	**0.46 to 0.67**
Coal handling	**0.06 to 0.08**
Ash handling	**0.07 to 0.10**
Pulverizers and auxiliaries	**0.10 to 0.15**
Boiler efficiency	**0.21 to 0.35**
Soot blowing	**0.10 to 0.15**
	$1.00 $1.50

** Includes investment cost fixed charges and cost of reduced efficiency with stand-by units.*

When it is considered that the average delivered price of coal to utility plants is about $7.00 per ton, the above increases in incremental costs are heavy penalties to pay for the utilization of inferior coals, and it is quite understandable why power plants are increasing their efforts to obtain higher quality fuels.

It is becoming more and more evident that the time honored method of calculating fuel costs on strictly a "cents per million Btu delivered" basis does not present a true fuel evaluation.

Mine Offering Better Coal Is Most Apt To Get Contract

As an example of such thinking, one company[f] using a coal having 9.7 percent moisture, 8.8 percent ash, 3.2 percent sulphur and 11,400 Btu as a base has set the following values for equivalent Btu adjustments per percent variation of moisture, ash, and sulphur.

Moisture	**60 Btu per percent**
Ash	**80 " " "**
Sulphur	**100 " " "**

Under this system, of two mines offering coal at an equal "$/million Btu delivered" cost, the mine offering the better quality coal is most apt to get the contract. This is shown by the following table.

	Mine X	*Mine Y*
Moisture	**6.0%**	**7.0%**
Ash	**7.0%**	**9.5%**
Sulphur	**3.0%**	**3.2%**
Btu/lb	**12,400**	**11,700**
$/ton f.o.b. mine	**$3.40**	**$3.20**
$/ton freight	**$3.00**	**$2.80**
Total $/ton delivered	**$6.40**	**$6.00**
$/million Btu f.o.b. mine	**$0.137**	**$0.137**
$/million Btu delivered	**$0.2580**	**$0.2560**
Quality adjustment-Btu	**386**	**106**
Adjusted Btu/lb	**12,786**	**11,806**
Adjusted $/million Btu delivered	**$0.2503**	**$0.2541**

Note: Figures in table above are not actual figures but are compiled by the author to illustrate the point.

This utility reports that five years experience under this fuel evaluation system has resulted in coal suppliers becoming very interested in correcting any condition which caused the delivery of poor quality coal. Conversely, bonuses have encouraged improved coal preparation.

20 Percent of All Raw Coal Mined Is Discarded as Reject

The bituminous coal producing industry has continually increased its efforts to market cleaner coals, and to deliver to its customers a product of ever increasing dollar value per ton to the extent that as of today, over

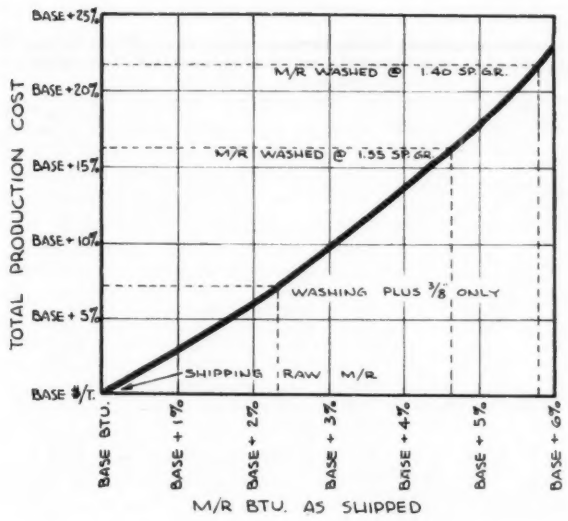


Fig. 5. Total product cost versus mine run Btu as shipped. Data was obtained from a recent study of three large operations shipping steam coals to eastern utilities (1959–1960)

20 percent of all raw coal mined is discarded at the mine as reject, and about 65 percent of all raw coal mined is shipped as mechanically cleaned coal. Granted, that much of this effort was of necessity to stay alive, but the industry must be given credit for its accomplishments while holding a tighter price line than that of any other raw material producing industry.

Cleaning Equipment Costs Fourth of Plant's Initial Cost

Since mine capacities vary so, it is not practical herein to attempt a complete cost analysis for all plants and therefore, for simplicity and brevity, let us consider a 1,000,000 ton-per-year preparation plant. The trend is toward larger mines, and today, mines producing between 500,000 and 1,000,000 tons per year account for over 50 percent of the country's annual bituminous production, even though in number, they represent only about three percent of the total mines in operation.

A modern mine capable of marketing 1,000,000 tons per year will require capital investment of about $8,000,000 including reserves and preparation facilities. Assuming this mine to produce about 400 tph, the capital cost of the preparation facilities will be about $1,200,000 if only coarse coals are cleaned, about $2,000,000 if mine run is washed and thermal drying utilized, and about $2,500,000 if multi-track loading and sizing is added to the mine run washing process.

It is interesting to note that in a typical preparation plant, the structure will require about 25 percent of the investment and miscellaneous conveying, electrical, etc., equipment will consume about 50 percent of the investment. The actual cleaning equipment will cost only the remaining 25 percent of the plant's initial cost.

Costs of cleaning coal are very difficult to assemble into any one table due to the variation in accounting systems; some plants load on rail, others on the river, and others into truck; some plants load several sizes of coal and others load a single product; and the fact that some plants are adjacent to the mine or mines while others handle coal from several mines. However, at the risk of incurring considerable disagreement, the following estimates are made for a typical three-shift, 300 tph plant with a raw feed containing 30 percent minus 3/8-in. coal and 20 percent reject.

(a) The cost of handling 5-in. by 0 raw coal, screening out the minus 3/8 in. washing and screening the 5 by 3/8 in. into the various loading sizes, and loading the 3/8-in. by 0 raw, including labor, supplies, power and depreciation will be about $0.40 per ton of plant output.

(b) The cost of washing, mechanically drying, heat drying, and loading the minus 3/8-in. coal along with necessary water clarification, including labor, supplies, power, and depreciation, will be about $0.75 per ton of 3/8 in. by 0 processed.

(c) The cost of combining (a) and (b) and handling 5-in. by 0 raw coal, screening at 3/8 in., washing both the 5 by 3/8 in. and the 3/8 in. by 0 and screening necessary sizes for loading including labor, supplies, power, and depreciation will be between $0.45 and $0.55 per ton of clean coal.

These costs have been increasing from year to year due to the rising labor and supply costs (figure 4).

Data compiled from extended records of a very well constructed and well operated plant processing 1,200,000 tons per year at 500 tph, washing to 0 in. with about 40 percent 3/8 in. by 0, heat drying, and with a plant reject of about 15 percent are shown in table II. These figures fairly well tie in with the above. The individual costs will vary from plant to plant, but in general these figures will apply to plants producing upwards of 250,000 tons per year.

Btu as Shipped Versus Total Production Cost

A recent study of three large operations shipping steam coals to eastern utilities has disclosed some very interesting data. Plotting Btu As Shipped against Total Production Cost (figure 5) resulted in the chart shown in figure 8. Placing arbitrary but practical values of 13,000 Btu as a raw coal base, 15,000 Mand A free

Table II. Data compiled from extended records of a well constructed and well operated coal preparation plant processing 1,200,000 tons per year (5 in. by 0) at 500 tph, washing to 0 in. with about 40 percent 3/8 in. by 0, heat drying and with a plant reject of about 1.5 percent

	Dollars per Ton		
	Labor	Supplies	Total
Raw coal handling	0.015	0.005	0.020
Coarse coal cleaning	0.015	0.012	0.027
Fine coal cleaning	0.014	0.006	0.020
Fine coal dewatering (mechanical)	0.005	0.007	0.012
Fine coal drying (thermal)	0.015	0.012	0.027
Water clarification	0.015	0.007	0.022
R.R. car loading	0.050	0.015	0.065
Refuse handling	0.015	0.010	0.025
Misc.	0.020	0.005	0.025
Total labor & supplies	0.164	0.079	0.243
Power			0.040
Labor, supplies, & power			0.283
Depreciation			0.200
Total			0.483

Btu, and $3.45 per ton as the production cost of shipping raw coal, points out several very interesting points illustrated in the following table:

Coal Shipped	Btu	Moist. Plus Ash	Production $/Ton	% Increase Btu	% Increase $/Ton
Raw	13,000	13.9%	3.45	—	—
5″ × ⅜″ washed	13,300	11.9%	3.69	2.3	7.0
⅜″ × 0 raw 5″ × 0 washed at 1.55 sp gr	13,600	9.9%	4.01	4.6	16.2
5″ × 0 washed at 1.40 sp gr	13,750	8.9%	4.20	5.8	21.7

As compared with shipping raw coal:

(1) Washing the 5 by ⅜ in. reduces the inerts only 2.0 percent but raises cost $0.24 per ton.

(2) Washing the 5 in. by 0 at 1.55 sp gr and drying reduces the inerts only 4.0 percent but raises the cost $0.56 per ton.

(3) Washing the 5 in. by 0 at 1.40 sp gr and drying reduces the inerts only 5.0 percent but raises the cost $0.75 per ton.

(4) Assuming that the ⅜ in. by 0 is 40 percent of the shipped washed 5 in. by 0, it could be assumed that washing and drying the ⅜ in. by 0 costs $0.80 per ton of washed slack.

(5) Assuming that it is necessary to wash at least the 5 by ⅜ in. to permit mechanical or continuous mining underground, it is apparent that shipping washed 5 in. by 0 is not justified on any kind of a straight cents per million Btu delivered basis.

Capital and operating costs for the cleaning of bituminous coals are high, but it can be fairly safely stated that at about 1.55 or 1.60 sp gr conditions are usually favorable to obtain (a) efficient separation of float and refuse; (b) high capacity from the cleaning equipment; and (c) fairly small loss of Btu in the refuse. Also, at these gravities the cleaned coal is usually satisfactory for steam uses. Washing at these gravities is normally a simplified process and much more economical than washing at lower gravities.

Washing Coal at Low Gravity Poses Problems

Table III[e] shows actual operating results and indicates the problems of trying to wash Pittsburgh seam coal at an extremely low gravity to produce a premium product. At 1.60 sp gr the "near gravity" material was only 9.7 and 2.4 percent respectively for the two coals and the efficiency of separation was good in each case. Very little coal was lost in the refuse

Table III. Operating results from cleaning Pittsburgh seam coal at 1.60 and 1.35 sp. gr. indicate the problems of trying to wash this coal at an extremely low gravity to produce a premium product

Sp Gr of Plant Operation	Washed Coal		Refuse		"Near-Gravity" Material ±0.10 Sp Gr at Gravity of Separation, Wt %	Total Misplaced Material in Washed Coal and Refuse, Wt % of Raw Coal
	Total Yield, Wt %	Refuse Not Removed, Wt %	Total Yield, Wt %	Coal in Refuse, Wt %		
Heavy-Medium (Magnetite) Process on 3-in. × ⅜-in. or 4-in. × 5/16-in. sizes						
1.60	96.10	1.20	3.90	1.90	9.70	1.22
1.35	29.50	9.50	70.50	6.50	61.00	7.40
Wet-Table Process on ⅜-in. × 100 mesh						
1.60	93.00	0.90	7.00	5.72	2.40	1.24
1.35	91.60	11.84	8.40	5.75	45.50	11.32

Table IV. Predicted washery results on four coals

Face Samples Crushed to 1½-in. Top Size. The 1½-in. × 100 Mesh Size Cleaned by Float and Sink. All Figures are on Dry Coal Basis.

1 Desired Ash in Clean Coal, % Ash	2 Predicted Washery Yield of Clean Coal, % by Wt of Feed	3 Heating Value of Clean Coal, Btu/lb	4 Btu in Feed Recovered in Clean Coal, % Btu in Feed	5 Fuel Lost in Washery Rejects from One Ton Feed, Btu	6 Value of Fuel Lost in Rejects per Ton Clean Coal at $0.17 per million Btu, Dollars	7 Sulfur in Clean Coal, % S
Pennsylvania, Allegheny County, Pittsburgh Bed						
10.0 (feed)	100	13,420	100.0	0	0.00	1.4
9.0	98	13,600	99.3	184,000	0.03	1.3
8.0	94	13,730	96.2	1,027,600	0.19	1.2
7.0	88	13,850	90.8	2,464,000	0.48	1.2
6.0	74	13,980	77.1	6,149,600	1.41	1.1
5.0	46	14,140	48.5	13,831,200	5.11	1.1
4.0	0	14,320	0.0	26,840,000	infinite	1.0
Ohio, Jefferson County, No. 6 Bed						
9.0 (feed)	100	13,470	100.0	0	0.00	2.3
8.0	98	13,610	99.0	264,000	0.05	2.2
7.0	96	13,750	98.0	540,000	0.10	2.1
6.0	93	13,890	95.9	1,105,000	0.20	2.1
5.0	87	14,030	90.6	2,527,800	0.49	1.9
4.0	70	14,180	73.7	7,088,000	1.72	1.6
3.0	36	14,330	38.3	16,622,400	7.85	1.1
West Virginia, Raleigh County, No. 5 Block Bed						
9.0 (feed)	100	13,890	100.0	0	0.00	0.7
8.0	98	14,030	99.0	281,200	0.05	0.7
7.0	95	14,170	96.9	857,000	0.15	0.7
6.0	88	14,320	90.7	2,576,800	0.50	0.7
5.0	79	14,470	82.3	4,917,400	1.06	0.7
4.0	60	14,610	63.1	10,248,000	2.90	0.7
3.0	27	14,780	28.7	19,798,800	12.47	0.7
Kentucky (Western), Hopkins County, No. 6 Bed						
5.0 (feed)	100	13,800	100.0	0	0.00	2.8
4.0	98	13,960	99.1	238,400	0.04	2.2
3.0	87	14,100	88.9	3,066,000	0.60	1.6
2.5	32	14,170	32.9	18,533,200	9.84	1.4

and very little refuse went out with the clean coal.

When operating at 1.35 sp gr, the "near gravity" material increased to the high percentages of 61.0 and 45.5 for the two coals. This high percentage of "near gravity" material interfered with the washing efficiency and misplaced material increased so that the washed coal contained 9.5 and 11.84 percent 1.35 sink and the refuse contained 6.5 and 5.75 percent 1.35 float.

With the big drop in yield and the poor washing efficiency, it is questionable that the improvement in ash content by washing the coarse coal at 1.35 could be economically justified.

Although yield held up, the misplaced refuse going out with the fine clean coal very possibly contributed sufficient ash to make fine coal washing at 1.35 impractical.

Since coal seams will vary in characteristic from mine to mine, each producer should make an effort to determine just what the most economical ash reduction should be, and then make every attempt to market coal cleaned to this extent.

Btu Loss Increases as Severity of Washing Increases

The U. S. Bureau of Mines ran laboratory tests to predict washery results on four coals to estimate the yields and analyses if each of these coals were cleaned commercially to yield premium products in steps of one-percent ash reduction. Findings were as follows (see table IV):

1. Columns 2 and 4, when compared, indicate that, with a reasonably clean feed coal, the percentage of feed Btu recovered in the clean coal very closely matches the washery yield in percentage of feed.

2. Column 5 shows the heat value (Btu) lost per ton of feed increases as severity of washing increases. These lost Btu, translated into lost dollars per ton of clean coal in column 6, were calculated at $0.17 per million Btu which is the equivalent to a price of $4.59 per ton of 13,500 Btu steam coal.

3. Sulphur reduction is moderate even with severe washing as shown in column 7. Reduction of sulphur by washing is naturally dependent upon the sulphur in the raw coal to start with, and in this test, reasonable economic sulphur reduction was accomplished only in the Ohio and Kentucky coals where sulphur was reduced 0.4 percent by running a 13 percent plant refuse and 1.2 percent with a 12 percent plant refuse respectively.

It is interesting to note what happens when the above analysis is applied to an actual case where Mine P is washing Pittsburgh seam 5 in. by 0 and where Mine Q nearby is washing only the 5 by ⅜ in. and shipping ⅜-in. by 0 raw. Both mines have similar production equipment and produce about the same percentage of ⅜ in. by 0 in the raw coal. Data in the same form as that presented by the U.S.B.M. tests is shown in table V.

Table V. If Mine P and Mine Q were shipping 5-in. by 0 mine run to a steam market all economic advantages would be with Mine Q due to lower capital costs, lower operating costs, and less loss in refuse. See text for full story

	Raw Coal	Mine P	Mine Q
1. Clean coal ash %	13.0	7.0	9.1
2. Plant yield %	100.0	90.0	94.5
3. Product Btu/lb	13,000	13,900	13,600
4. Btu recovery %	100.0	96.3	98.9
5. Btu loss/ton feed	0	980,000	280,000
6. Fuel $ lost per ton of clean coal (@ $0.17/million Btu)	$0.000	$0.185	$0.050
7. Clean coal sulphur %	2.10	1.60	1.82

Recovery Comparison
Raw Coal—Pittsburgh seam mechanically loaded
Mine P —Shipping 5" x 0 washed
Mine Q —Shipping mixture of 5" x ⅜" washed and ⅜" x 0 raw

Study of this data will reveal that while Mine Q will only reduce raw coal ash 3.9 percent as against 6.0 percent at P, Mine Q will recover an additional 2.6 percent of the raw feed and the cost of fuel losses per clean ton (line 6) will be a theoretical $0.135 per ton lower. The sulphur will be only 0.22 percent higher. If these two mines were shipping 5-in. by 0 mine run to a steam market, certainly all economic advantages would be with Mine Q due to lower capital costs, lower operating costs, and less loss in refuse.

The writer is aware that all mines do not ship crushed mine run to utility steam markets and that at a large percentage of coal mines certain top sizes are screened out for industrial use.

The Small Operator Must Be Encouraged To Stay in Business

The usual problem that confronts the producer usually boils down to the perplexing question of "what do we do with the slack?" Let's look at the questions that confront a typical small operator producing around 200,000 tons per year. His problems are those of many and his success or failure can very likely depend on his arriving at the most correct answers to his questions.

Mine Z produces 200,000 tons per year from a mechanized mine using eight to 10-year-old equipment and with a moderately efficient cleaning plant arranged to wash to ⅜ in. His customers are many and his market confined to industrial steam and electric utility steam generating plants. The mine has shown a small profit for several years and financial reserves are adequate but limited. However, with the recent labor rate increases and increases in cost of supplies, the margin of profit is approaching a minimum and if further decreases occur, his return on capital investment in plant, equipment, and reserves will drop below the economic limit.

Operator Z can improve his mining costs by purchasing new up to date underground face equipment and improve labor costs, but if tonnage increases as necessary, some additional haulage equipment will be needed. Quite a few thousands of dollars are required as a capital expenditure to do this, but the problem will still not be solved.

A big factor in the reduction of profits is the fact that this mine fills several high quality month to month industrial orders and one high quality short term utility order. In doing so, however, coarse washed coals and only a very small portion of the high ash raw ⅜ in. by 0 is shipped to these customers and a major portion of the raw ⅜ in. by 0 is left to be "dumped" at a realization as much as $2.00 per ton below production costs.

The operator has been offered a longer term utility order at larger monthly shipments but will have to rob more coarse coals from industrial orders to do so and will still wind up with a large part of the raw slack to be "dumped." Calculations indicate that the final net realization will improve only very little if this is done, and it seems quite probable that any high realization industrial orders shorted or turned down will be forever lost.

If the operator accepts a still larger utility order that will permit him to

(Continued on page 59)

Open Pit Operations in the Gas Hills Area of Wyoming

Active companies in the area stripped 25 million cu yd of waste in 1959

By ROY COULSON
Division Superintendent
Vitro Minerals Corp.


Aerial view of Western Nuclear's open pit mining operations in the Gas Hills area

THE Gas Hills area of Fremont County, Wyo., is located some 50 miles southeast of Riverton and some 78 miles west of Casper. The area generally is semi-arid with an average rainfall of 7 to 14 in. The topography for the most part is gently rolling hills covered with a low growth of sagebrush, which makes for easy access. Winters are usually quite severe with temperatures of minus 30° and 40° being common. High winds are also common and even the slightest snowfall drifts quite badly. The summers are generally hot and dry.

The first discovery of uranium was made here by Neil McNeice and his wife in September 1953. The property that Neil discovered and subsequently staked has become the operations of the Lucky Mc Division of Utah Construction & Mining Co.

Discovery of uranium in the Gas Hills led to considerable staking activity, in the years 1954–1955 there were as many as 40 different companies active in the area. More than 25,000 claims were staked at the peak of the rush. In the summer of 1954, Vitro Minerals Corp. purchased property adjoining the original find of McNeice from Sateco Mining Co. Vitro then, like others in the area, initiated an extensive exploration program and by early 1955 had blocked out sufficient tonnage to make a small mining operation practical.

Mining of Oxidized Pods Comprised Early Efforts

The first ore bodies discovered and mined in the Gas Hills area were at the surface or near the surface and ranged from 1000 to 10,000 tons in magnitude. Most of the ore is found in poorly consolidated Tertiary sediments in the Wind River formation at depths that vary generally from 0 to 200 ft.

The first pit was that of Lucky Mc, mining small oxidized pods from the surface down to perhaps 20 ft by the use of front-end loaders, small shovels, bulldozers, and trucks. Early in the 1954–1955 period, it was thought that the major portion of the ore occurred in these small pods in the oxidized sediments. They were of medium to high grade but were very spotty in nature.

Vitro also mined these small pods and stringers, pursuing them through the use of front-end loaders, hand shovels and a black light.

In February 1955, Vitro moved an 80-D Northwest 2½-yd dragline and a D-8 Cat into the Gas Hills for the purpose of opening up what appeared to be a deeper but more consistent ore horizon. This horizon, locally called the unoxidized or blue zone, up to this time had been overlooked or at least had not been exploited. The first pit was some 40 to 50 ft deep and 600 ft. long. It was the first open pit as such in the Gas Hills area and opened up the unoxidized ore horizon.

The knowledge of this lower horizon led to an extensive drilling program by Vitro, Utah Construction, who had entered the Lucky Mc picture, and others in the field. This drilling program jumped the ore reserves in the area from perhaps 200,000 tons in early 1955 to several million tons in early 1956. The opening of an ore buying station by the Atomic Energy Commission in Riverton in March 1955 also spurred mining during this period, for up until this time there was no local market for the ore.

During this time, other operators were turning to road contractors to do their initial stripping for them. Contract prices were in the neighborhood of 28 to 40 cents per yd. One such pit was the Redwood mine of Two States Mining Co., which was stripped to a depth of 162 ft. Western Nuclear Corp. also turned to contractors and successfully stripped the Bull Rush pit to a depth of about 90

ft at costs generally conceded to be in the neighborhood of 28 cents per yd.

Hodgepodge of Stripping Equipment

Utah Construction, at their Lucky Mc mine, commenced stripping an area 400 ft by 1100 ft in their 1-A pit to a depth of 70 to 90 ft with a 2½-yd shovel and 20-yd Euclid trucks. They also opened a pit roughly 1700 ft by 600 ft with a depth of 80 to 120 ft employing 34-yd Woolridge MRS Scrapers and D-9 Cats.

During these early days, stripping was being done with a hodgepodge of equipment. One could see almost any type of operation in a trip through the area. There were front-end loaders and trucks, shovels and trucks, tractors, tractors and scrapers, and draglines.

In Vitro's case, conditions warranted staying with draglines and using the cut-and-fill method of stripping. This was due to the character of the ore body which was a single, fairly uniform and almost even surfaced, blanket-like deposit varying in depth from 40 to 120 ft.

The company, therefore, in the fall of 1956 moved in a Marion 7200 walking dragline to supplement the 80-D. The machine was equipped with a 135 ft boom and a five-cu yd bucket. It cast about 4300 cu yd per day, back filling into the mined out area.

In 1955–1956, Vitro was producing 40 to 50 percent of the ore in the Gas Hills area, yet in 1955 the company moved only 163,000 cu yd of waste and in 1956 it moved 287,000 cu yd of waste to produce some 60,000 tons of ore.

Slopes of walls in these Wind River sediments came up for a great deal of discussion when it was apparent that the mining was going to be almost exclusively open pit. There was much argument both pro and con and even attempts to have consideration for legislation of pit slope standards. This was bypassed, however, and most operators settled on pit wall slopes in the order of ½ to 1. This has proved to be adequate, and aside from one slip in a badly faulted and fractured area, there has been no trouble.

The over-all safety record of the district has been quite good. Vitro, for example, has operated for five years without a fatality and with only one serious accident—an eye injury in 1959.

Waste Removed with Scrapers and Tractors

Things were getting into high gear by January 1957. Western Nuclear had a mill under construction, which was put on stream in July 1957, and Lucky Mc also had a mill under construction which was completed in March 1958. Under the impetus of this new market, mining and stripping took an upswing in 1957.

Dragline working and loading ore at the Frazier-Lamac pit of Western Nuclear. This pit is over 300 ft deep

By the end of that year, an additional 4,366,000 cu yd of waste had been removed to recover 296,000 tons of ore—Utah Construction moved 1,800,000 cu yd of waste; Vitro, 1,338,000 cu yd; Western Nuclear, 666,323 cu yd; and the balance of the operators, 562,000 cu yd. Of the 296,000 tons of ore, Vitro recovered 104,000 tons.

That year also saw 802 men employed in the area, which doubled the number of the previous year. One might say that 1957 was the upward turning point of the area.

By 1959, Utah Construction had geared for 700,000 cu yd of waste removal per month and Western Nuclear, through its contractor Maco Construction Co., had geared to 1,000,000 cu yd per month. Utah, in 1959, moved 8,000,000 cu yd of waste, and Western Nuclear moved 13,000,000 cu yd in the Frazier-Lamac pit, which is now over 300 ft

Ore control discussion at the Globe pit. Loading is directed by an ore control man using a counter

All truck loads are checked radiometrically when they leave the pit, and the ore is stockpiled according to the radiometric count in five grades. This view is of Vitro's John "B" pit

deep. Western Nuclear is employing 22 scrapers and 9 tractors to move this overburden on an around the clock schedule. Utah Construction utilizes 16 scrapers and 9 tractors.

Early last year, Vitro changed over to rubber-tired scrapers pushed by D-9 tractors and sidelined the Marion dragline. This was due to the mining out of the blanket-type deposits and the start of mining multiple horizons in wide, extremely thick ore sections. The company, which now employs four DW-20 scrapers and two D-9 pushers to do the stripping, moved 2,339,000 cu yd in 1959. The number of men employed in mining in the district rose to 1177, and nearly 25,000,000 cu yd of waste were moved—five times that of 1957—to produce some 825,000 tons of ore.

Stripping costs in the area vary greatly and probably average about 24 cents per cu yd. Vitro's costs, the only ones that the writer can quote with authority, ran from 12 cents to 50 cents per cu yd with the dragline and averaged about 18 cents. These are direct costs and do not include an additional 4 cents for blasting. With the rubber-tired scrapers, the average direct cost is running 17 cents per cu yd.

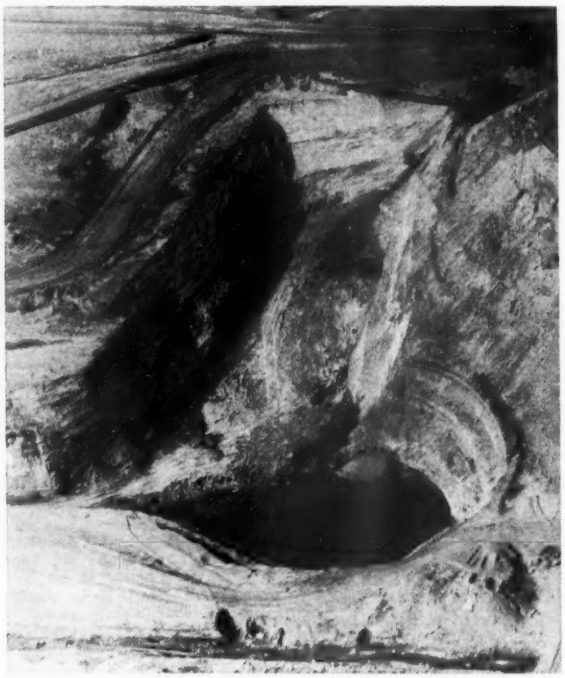
Ore is Similar to Waste in Appearance

Mining of the ore in the Gas Hills is the most complicated of our problems. The ore occurs in spotty lenticular pods throughout the 100 or more foot sections which were mentioned previously. The color and physical makeup of the ore is not very much different from that of the rock surrounding it. Radiometrically, it can be out of equilibrium in either direction.

Vitro and the other operators in the field use front-end loaders, shovels and backhoes for ore loading purposes. These units are all controlled by an ore control man using a counter. The operators work around the ore pods with front-end loaders and shovels, removing the waste material first and then the ore. With backhoes, the narrow, sinuous channels are dug out as clean as possible. The ore is then stockpiled.

All truck loads are checked radiometrically when they leave the pit, and the ore is stockpiled according to the radiometric count in five grades: 0.05 to 0.07; 0.07 to 0.10; 0.10 to 0.20; 0.20 to 0.40; and 0.40 to 0.60 and 0.60 plus. The stockpiles are closed when they reach a total of 2000 tons. A 100-lb sample is taken from each load when a truck is dumped, and the samples are windrowed alongside their respective stockpiles. The samples are then resampled by the channel technique and the composite is crushed, split and pulverized and a portion sent in for assay. It is on the basis of this assay that blending for shipping is carried out.

The person responsible for radiometrically checking the loads of ore coming from the pit is instructed to be on the alert for anomolous counts. If he detects a count which is not in the same range as the general count of the load, he takes the counter to the pit and tries to locate the reason for the anomolous count so that the ore can be separated in the pit and loaded clean.



In 1959, nearly 25,000,000 cu yd of waste were moved in the district—five times that of 1957. Shown here is one of Vitro's pits in the Gas Hills

Mining Costs Vary from $4.63 to $10.00 per Ton

Operators in the Gas Hills have been quite successful in ore control. For instance, 70,000 tons of 0.23 percent U_3O_8 ore was mined out of the one control area that had been estimated by the exploration geologist to contain 60,000 tons of 0.25 percent U_3O_8. Over the entire period since 1955, Vitro has maintained an average shipping grade of 0.21 percent U_3O_8 while shooting for an 0.20 percent average.

Total mining costs in the area vary somewhat. One company reports costs of $5.50 per ton, another $5.98 and some $10.00 per ton with an average of $6.00 to $7.00 per ton. Total direct costs at Vitro average at present $4.63 per ton direct ore, and lifting costs 87 cents per ton. The present ratio is about 1:18.5.

Water has not been a serious problem with Vitro although some of its neighbors have pumped as much as 2300 gpm or over 3,000,000 gal per 24 hours.

There are five mills at present operating in or within a radius of 50 miles of the Gas Hills: Lucky Mc, Globe Mining, Western Nuclear, Susquehanna-Western and Federal Partners. There are 18 to 20 years of reserves at the present mining and new discovery rate.

As previously stated, over 40 companies were active in the early days of the area. Ore production was around 60,000 tons plus and yardage moved was in the neighborhood of 500,000 cu yd of waste.

Today the active companies in the area include Globe Mining Co., Union Carbide Nuclear Co., Utah Construction & Mining Co., Western Nuclear Corp., Federal-Gas Hills Partners, Dale B. Levi Co., Western Uranium Corp., Fairfield-Anderson & Beach, Hidden Splendor Mining Co. and Vitro Minerals Corp., moving some 20 to 30 million cu yd and producing some million plus tons of ore while giving direct employment to over 1100 men.

MAINTENANCE of TRACK HAULAGE SYSTEMS

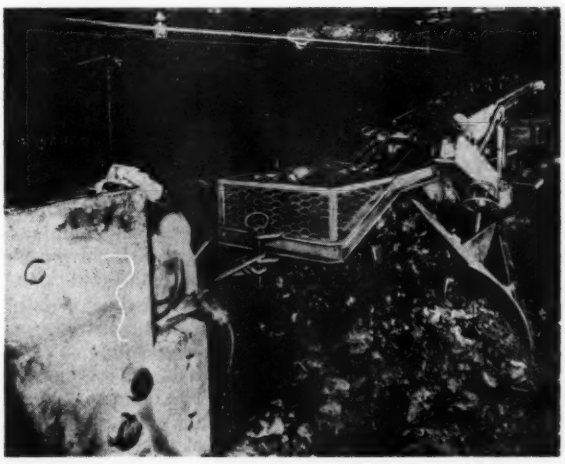
By J. S. SCHRECENGOST
Chief Engineer
Allegheny River Mining Co.

Installing a rail haulage system? Get the best possible equipment available! It will save you money in the long run

IN the past few years there has been a phenomenal increase in the use of belt conveyors for the haulage of coal. However, it is incorrect to assume that there has been any great or rapid decline in the use of track haulage systems. Most operators today employ both systems, the track being used on main line haulage and the belts on panel development. This combination system has gained much favor with the operators of mines which are geared to large capacities and those which cover wide areas of development. Even those mines which handle coal entirely by belt usually have a track system for transporting workmen and supplies.

A track haulage system properly installed with the best available materials today is the most nearly continuous, interruption free and safest type of haulage. Major advantages include:

1. **The safety of transporting the men in and out of the mine in personnel cars.**
2. **Easy and rapid transportation of supervisory personnel.**
3. **A temporary shutdown occasioned by a roof fall or power failure along the haulage system will not shutdown the production areas.**
4. **Quick availability of repair parts or supplies.**
5. **Large pieces of coal or rock can be handled without damage to the haulage equipment.**
6. **In areas where there is a wide range of noticeably changeable quality characteristics, the different cars may be selected for special preparation.**
7. **Rock or equipment may be loaded and moved out of the mine without interference with the production or preparation of the coal.**



Rapid cleaning of the haulageways at Allegheny River Mining Co. is achieved with a track cleaner such as the one pictured above. Under normal conditions, two men can clean from 1000 to 2000 lineal ft per shift using this type of machine

In view of these facts, it would seem inevitable that rail haulage will be with the mining industry for many future years. Consequently, it behooves all segments of mine ownership and management to give careful consideration to every item which goes into a track haulage system because the maintenance cost of each system is greatly dependent upon the material and type of construction used. It should never be forgotten for a minute that the maintenance problem will be with them at all times for the life of the mine. Their haulage system must be competitive cost-wise on maintenance as well as on production. Therefore, in the installation of a rail haulage system, it is unwise to weigh too heavily the initial capital investment for the best installation of the most modern equipment against the use of obsolescent or semi-obsolescent equipment just because it happens to be on hand or readily available. It will cost much more over the life of the mine and ultimately will have to be replaced.

Grades on Main Line Should Not Exceed 3½ Percent

Let us consider the type of rail, trolley wire, feeder lines, switches, signals and grades which will be conducive to low-cost maintenance. The main haulage track system should consist of 85 lb or even 100-lb steel

Modern mine haulageway showing prefabricated track layout capable of handling large volume of heavy traffic

rails which may be either bonded or welded and laid on preservative-treated wood ties. The track should be carefully graded, ballasted and drained. Curves in main line haulage should have a radius of 200 to 500 ft, depending upon the size of the equipment, and should be superelevated. The grades, either for or against the loads, should not exceed 3½ percent. A long sustained grade against the loads should not exceed two percent.

Trolley wire should not be less than 6/0 in size and installed on the "tight" side in conformance with the rules and regulations of the State and U. S. Bureau of Mines. It should be hung at a uniform distance above the rail and properly aligned with the rail at the proper outside spacing. For the lowest maintenance and best and most efficient power collections, the writer prefers the shoe type collector on heavy duty locomotives. The trolley wire should be properly lubricated at regular time intervals. Feed line wire in most cases should not be less than 1,000,000 CM in size and connected to the trolley wire at regular intervals.

The advent of larger cars and locomotives has accentuated the maintenance problem in such items as flange and tread wear along with frog and switch-point deterioration. This problem, however, has been minimized by the development of flange oilers, pressed-on tires, alloy frogs and switch-point protectors.

Unnecessary stopping and starting of long trips of either loads or empties is not conducive to low maintenance costs or the lowest power consumption. Much of this sort of thing can be eliminated by the installation of carrier-current phones on the locomotives and in the communication centers. The use of signal block systems with electric switch throws, automatically actuated by trolley wire contacts, are both practical and economical and tend to promote safer haulage which will minimize derailments and wrecks which add so much to the cost of maintenance.

Locomotives Should Be of Adequate Size

Next, let us dwell briefly on the rolling stock involved in the maintenance of track haulage systems.

Mine cars. At the present time, the use of wood or wood and steel mine cars has practically been discontinued because of high cost maintenance. The selection of the proper type of steel mine car is usually determined by trying to obtain the most favorable ratios between the capacity per pound of dead weight and capacity per dollar of investment. The use of specialty steels, such as high strength and alloyed types, may increase the original cost but require much less maintenance. In many cases, the use of spring bumpers and automatic couplers is fully justified. These features enable the trip to be made up with maximum speed and safety. It also cushions the shock of jolts between the cars, thus reducing the spillage and resulting cost of haulageway cleaning and loss of coal. Overloading of mine cars usually results in too much track cleaning and therefore should be avoided. Mine car maintenance on rail haulage systems can be greatly reduced by the installation of antifriction-bearing wheels and wheels made from special alloys and chilling with cast iron along with cast or forged steel.

Locomotives. For the lowest maintenance, locomotives should always be of adequate size to handle the job. In many cases, great savings can be made by eliminating two or three small locomotives and replacing them with a single large unit. This not only reduces maintenance on several units but greatly reduces the necessary man power to operate them. Pneumatic or hydraulic brakes are necessary on main haulage locomotives and in many cases the cost of dynamic electric braking is fully justified. As in most track equipment, preventive maintenance on locomotives pays large dividends. Periodic inspection of brakes, wheels and bearings, along with megger tests on the electrical equipment will greatly reduce costly breakdowns which might even cause wrecks, great damage or perhaps loss of life.

Track installation and maintenance can be greatly speeded in most cases by the use of a mechanical track tamper. The most effective unit is self-propelled and has four air actuated tamping bars.

Good Housekeeping Poses Major Problem

Obviously, one of the greatest problems facing management today is that of good and proper housekeeping on underground haulage roads. Regardless of the type of mine cars in use, there is coal spillage at sags in the grade, low roof points and from the drop bottoms, end gates or sides of the mine cars. In addition to the coal spillage, mines are always confronted with the disintegration and spalling of the top and side rock or slate along the haulageways. A portion of this material that accumulates on the haulageways finds its way into drainage ditches and sumps and may cause drainage complications. Furthermore, when combustible material is left along a haulageway, it is mandatory that such material be rock-dusted and that samples will show at least 65 percent of incombustible material. This makes rock-dusting a very costly operation unless a rigid track cleaning schedule is adhered to. The most favorable psychological factor affecting the opinions of inspectors, visitors and owners, is a good clean track system. Therefore, since a good clean track system is imperative for the cheapest and best maintenance, keeping it in that condition by the use of men with picks and shovels is as outmoded as sweeping rugs and carpets with a broom.

The mines of Allegheny River Mining Co. use a Model "30" Canton track cleaner and the results obtained from its use have been highly satisfactory, giving them both rapid cleaning and the lowest possible maintenance cost. This machine operates on the principal of plowing the material from a minimum of six in. outside of the rails to a maximum of 54 in. from the center line of track, all between the rails. This material between

the rails is forced back over a digger plate by a gathering conveyor and onto a boom conveyor which discharges into a mine car. The gathering conveyor floats with the size of the lumps and the car hitch telescopes in order that long cars may be loaded from end to end. The machine is 100 percent hydraulically equipped; therefore, it requires no manual labor. The almost instantaneous adjustment, possible by the hydraulic system, permits the loading of more material than the loaders which have to be manually adjusted. The fluid coupling provides a cushion for shock loads and prevents breakage. The cleaner and the car being loaded are hauled by a locomotive. The company has loaded as much as 100 tons per shift when conditions were favorable. The lineal foot of track which may be cleaned per shift is dependent, of course, upon the frequency of cleaning and the accumulation of material to be removed. Under normal conditions, the company expects two men to clean from 1000 to 2000 lineal ft per shift using the Canton cleaner. Where regular cleaning is practiced, a large percentage of the road cleaning is salvageable coal which is reclaimed in the preparation plant, thus, in many cases, offsetting the cost of cleaning the haulage tracks.

In closing, there has been too much consideration giving to holding down the original capital expenditure and thereby prohibiting the best construction and use of the best equipment. It is not the matter of how much an installation costs, but the rapidity with which that investment can be amortized in the maintenance of the system.

SOME ECONOMIC ASPECTS OF COAL PREPARATION

(*continued from p. 53*)

ship all the raw 3/8 in. by 0 blended with washed coarse coals, the quality of his utility product will be such that, if the purchasing policies of the utility become more stringent, his product will be borderline and his continuance as a coal supplier cannot be assured. Loss or curtailment of the utility order would then leave him with only very limited industrial outlets or the prospect of reducing his price on the utility coal. Either way, his economic picture is poor.

Investigation has shown that both from a capital investment standpoint and from an operating cost standpoint that wet cleaning of the 3/8 in. by 0 with the attendant reject losses and drying costs will add about $0.300 per ton to his total production cost. Since his raw 3/8 in. by 0 is only about 20 percent of his crushed mine run, this $0.30 per ton increase on the over-all product is just about equal to the losses he suffers when he sells about three-fourths of his raw slack or 15 percent of his over-all product at a $2.00 per ton loss. His capital investment then in these additional wet fine coal facilities would avail him relatively nothing.

It has also been determined that the installation of limited air cleaning equipment washing the 3/8 in. by 0 will, in this case, add about $0.15 per ton to the total production cost and permit a possible increase in net realization of about $0.40 per ton. This increase, percentagewise, is considerable, but it must be remembered that, since available capital funds are channeled in this direction, no improvement in mining cost can be anticipated, and one more increase in labor rates is likely to wipe out the income improvement.

Now, if a long term utility contract could be acquired whereby the washed coarse coals and the raw 3/8 in. by 0 could be shipped, the present required price f.o.b. the mine could be reduced $0.10 to $0.15 per ton. The mine could then spend the available capital funds for improved face and haulage equipment and reduce mining costs as much as $0.50 per ton.

From the utilities standpoint, this mine's problem may be considered that of the operator only, and in these times of oversupply, the utility may be most prone to feel that present purchasing policies are to its best advantage. However, if recent estimates predicting utility usage of coal to exceed 450,000,000 tons in the not too distant 1975 are correct, smaller mines like Mine Z above will be badly needed and additional efforts must be made to encourage them to stay in business.

0.88 Lb of Coal Required To Produce One Kwh

Utilities have been continually able to decrease the pounds of coal burned per kilowatt-hour produced. In 1938 about 1.4 lb of coal were required to produce one kwh of electricity, and this figure was reduced to about 1.3 by 1948. The estimated consumption in 1960 is about 0.88 lb of coal. Certainly the technological developments and inception of new plants and plant designs have been largely instrumental in bringing about this phenomenal improvement, but it also must be remembered that the coal industry, year by year, has continued to supply higher quality coals, and their share of credit for the above improvement cannot be taken lightly. Since coal prices f.o.b the mine have held the line or decreased, it might be said that the individual coal producers have paid for a large share of the reduction in utility fuel consumption per kilowatt-hour by their increased capital investment in coal preparation equipment and thru their increased operating and maintenance costs due to shipping cleaner coals.

It is estimated that this country will be using 75 percent more energy in 1975 than it is using today. If the coal industry can be fairly committed to furnishing 450,000,000 or more tons as utility fuel at that time, it is necessary that the utilities redouble their efforts to appraise present and future coal burning programs. At the same time the individual operators, the various associations, technical groups, etc., of the coal industry should appraise the required costs of meeting the future utility demands economically. Out of these joint efforts, it is to be hoped that the utilities can arrange to burn a fuel that is economical for the utility to burn and economical for the operator to prepare.

ACKNOWLEDGMENTS

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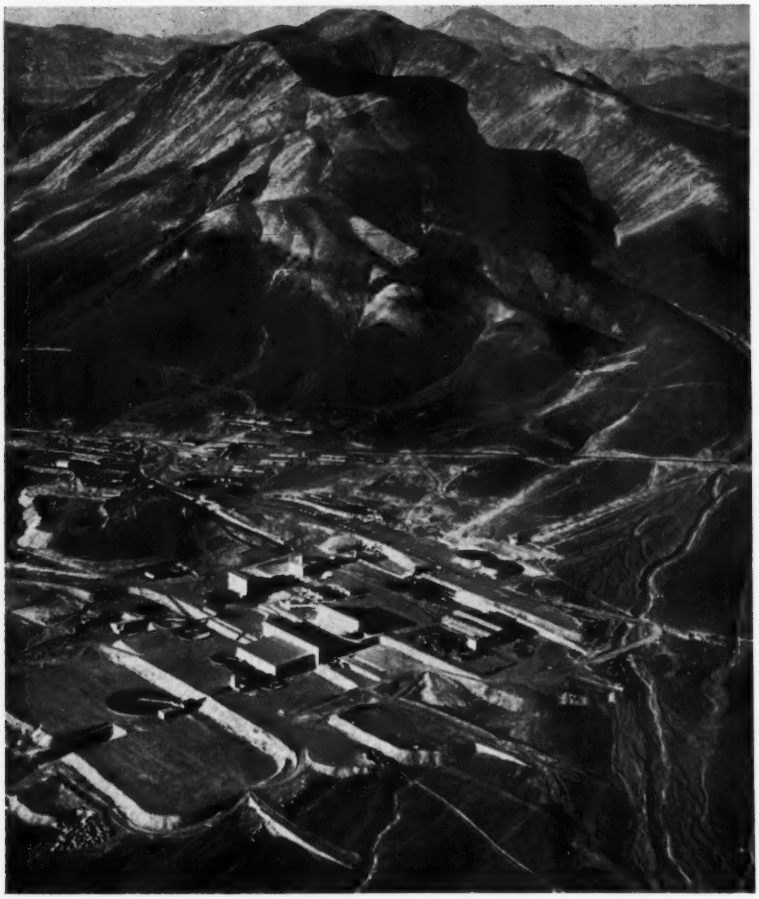


The El Salvador Mill

New 24,000-tpd mill features four identical concentrator sections

By PETER B. HOBSBAWN
Plant Superintendent—Metallurgical Operations
Andes Copper Mining Co.

THE El Salvador mill of Andes Copper Mining Co. is situated in the Chilean province of Atacama, about 75 miles from the port of Chañaral and 20 miles from the mining town of Potrerillos, at an altitude of 7700 ft above sea level. Construction of the mill was started in 1957 and the first copper concentrates were produced in May 1959; the first molybdenum concentrates were produced in November of the same year. By April of the following year, all four sections of the concentrator were in continuous operation. The mill is designed to treat 24,000 tpd of ore, with the possibility of increasing this to 30,000 tpd. Present rate of treatment is about 20,000 tpd.

Deposit Contains About 1.6 Percent Copper

Ore is obtained from an ore body in the 11,000 ft high Indio Muerto mountain at the foot of which the mill stands. The deposit, with an average copper content of 1.6 percent, consists of secondarily enriched sulphide disseminations and stockworks in andesite and granodyoritic porphyry.

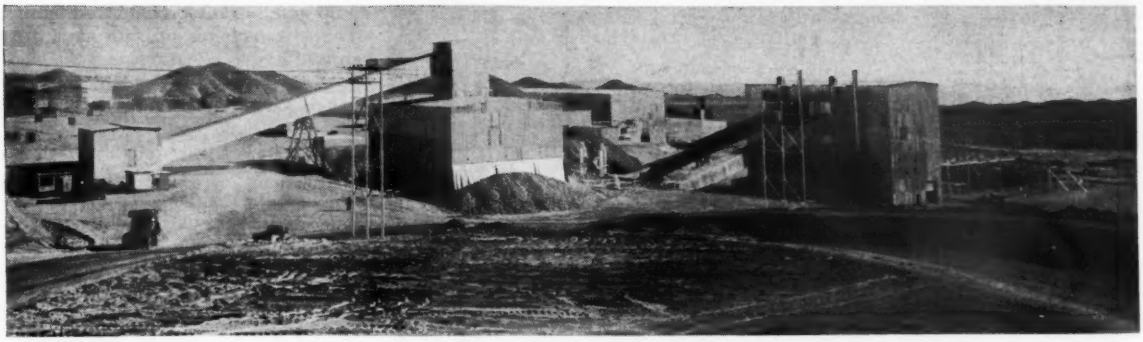
The principal ore mineral is chalcocite, which occurs in both the sooty and the steely variety, as replacements and coatings on primary sulphide minerals. Covellite is a minor secondary mineral in some parts of the orebody. Primary minerals are chiefly chalcopyrite and pyrite, with some bornite present in subordinate quantities. Bornite is the most easily replaced of the primary sulphide minerals, while pyrite is the most resistant to replacement. As a result, much of the enriched pyrite in the ore is only covered by films or thin coatings of chalcocite.

The degree of chalcocite replacement of primary sulphides varies with the position of the ore within the enrichment blanket. It is estimated that 75 percent of the copper in the ore currently being supplied to the mill occurs as solid chalcocite, 15 percent as chalcocite coatings on pyrite and 10 percent as chalcopyrite.

The nature of the bulk of the gangue minerals in the ore depends principally on the degree of alteration of the host rock. In weakly altered areas, the rock is composed of quartz, potassium feldspar, plagioclase and biotite. In altered areas, the feldspar and biotite have been converted to sericite, aluminous clays and chlorites. As regards physical character, strong alteration and abundant fracturing produce soft, easily crushed ore, while weak alteration, with abundant quartz veining, result in a more competent rock.

Fine Grinding Required to Liberate Copper Minerals

The ore as it leaves the mine is well broken up, with a high primary slime content. It requires fine grinding in order to liberate the finely disseminated sulphides. Briefly, treatment consists in size reduction carried out in three crushing stages and two wet grinding stages; separation of a bulk concentrate by flotation of the sulphides, and further wet grinding of the bulk concentrates, followed by two cleaning stages and a scavenger stage.



General view of crushing plant area showing coarse ore storage in center foreground

The copper concentrates so produced are processed for the separation of molybdenite before being sent to the smelter.

Ore is dumped through 18-in. grizzlies into the underground ore bins, from which it is hauled in trains of fifteen 50-ton bottom dump cars and dumped into two unloading bins, of 350 tons nominal capacity each, one to each primary crushing unit. The ore is drawn from the bottom of these bins by means of four 6 by 14-ft pan feeders and delivered, over grizzlies with six-in. openings, to two 30-in. gyratory crushers, set up on 40-ft centers parallel to the ore haulage track. About 40 percent of the ore goes to the crushers. Large pieces of wood and tramp iron and steel are picked off the pan feeders.

The grizzly undersize joins the crusher product in two surge bins, one to each crusher, from which it is drawn out by two 6 by 11 ft pan feeders discharging on to a single 54-in. wide belt conveyor, which delivers it to the coarse ore bin. With both gyratory crushers operating and set to produce a 5½ in. product, a train of ore can be handled in 15 minutes. Present practice is to operate only one crusher at a time.

Secondary Crushing to ⅜ In.

The coarse ore storage consists essentially of a circular pile of ore 175 ft in diameter and 65 ft high with a superstructure supported on columns covering the active area. When full, the bin holds 26,000 tons, of which 7000 tons can be drawn off. A magnet, suspended over the conveyor head pulley, removes tramp iron from the ore as it is discharged into the bin.

Two 36-in. wide belt conveyors, each fed by four 48 by 72 in. vibrating feeders, convey ore from the bottom of the coarse ore bin to two identical sections of the secondary crushing plant. Magnets, suspended over each conveyor head pulley, remove tramp iron from the ore.

Each secondary crushing unit is composed of a pyramid of three crushers, with vibrating screens operating in open circuit with them, the ore flowing by gravity throughout. Each 36-in. belt conveyor discharges the ore to a 6 by 14-ft single deck vibrating screen, with 1½-in. slotted openings. The screen oversize is crushed in a seven-ft standard cone crusher, set to 1¼-in., and the crushed product, together with the screen undersize passes over four five by ten ft single deck vibrating screens, with 11/16-in. slotted openings, arranged in pairs on each side of the standard cone crusher.

Oversize from each pair of five by ten ft screens is crushed in a seven-ft shorthead cone crusher, set to ⅜-in., and the crushed product from all four shortheads, together with the screen undersize from both sections, is received on a single 60-in. wide belt conveyor, equipped with a recording belt scale, and conveyed to the fine ore storage. This bin is similar in design to the coarse ore bin, is 270-ft long and has an active draw-off capacity of 24,000 tons.

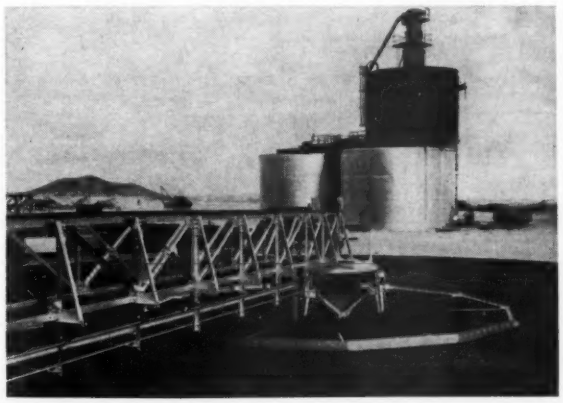
Under present conditions, production can be maintained by operating both sections of the secondary crushing plant 12 hours daily.

Four Independent Sections in Concentrator

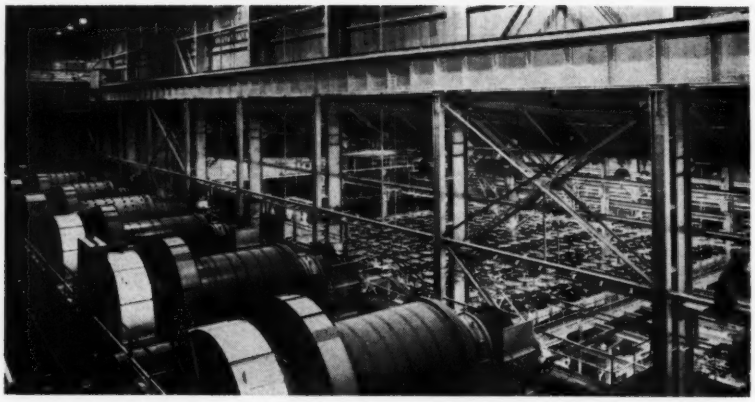
The concentrator consists of four identical sections. Ore for each section is drawn from the bottom of the fine ore storage on to a 24-in. wide belt conveyor by means of four 30 by 96-in. vibrating feeders. Each conveyor is equipped with a belt scale working in conjunction with a tonnage recorder situated at the control station on the grinding floor. This instrument will also maintain a preset feed rate, by modifying the degree of vibration of the feeders. The conveyor delivers the ore to the rod mill feed chute, where milk of lime is added and sufficient water to maintain 70 percent solids in the rod mill discharge. The ore is ground in the 10 by 14-ft rod mill, operating at 60 percent of critical speed, to about five percent plus ten mesh at present tonnage.

The initial rod charge consisted of 34 tons of 3-in. 2½-in. and 2-in. diam steel rods, 14-ft long, and a make-up charge of 0.55 lb of steel per ton of ore ground, or nine rods per mill, is added. Grinding rods are stored in a pit located just outside of the concentrator and the rods are handled by means of two magnets suspended from a monorail hoist.

The rods to be charged to the mills

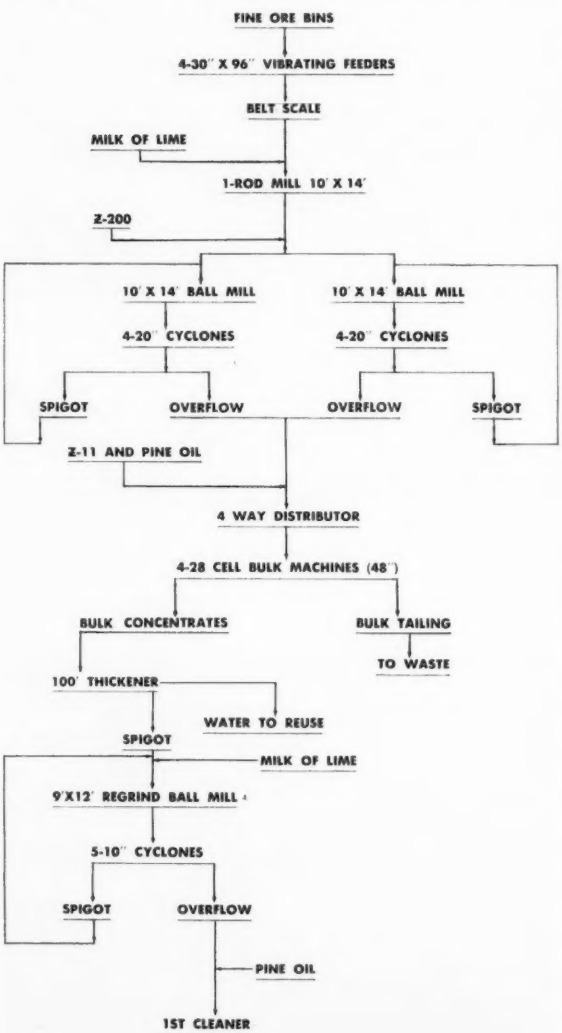


Concentrate thickener with lime slaking plant showing in background



View in concentrator showing 10 by 14 ft ball mills and flotation section. Each ball mill operates in closed circuit with four 20-in. wet cyclones equipped with 7½ in. vortex finders and 3-in. apexes

are loaded on to a car, hauled by a battery-operated tractor, and unloaded on to a storage rack situated by each rod mill. A stationary rod charging machine of the telescoping type, located next to the storage rack and in front of the rod mill, charges the rods into the mill. This arrangement is made possible by the position of the rod mill, which is at right angles to the ball mills.



Flowsheet of grinding and bulk flotation sections

Ball Mills Operate in Closed Circuit With 20-In. Cyclones

The discharge from each rod mill is split to two 10 by 14-ft scoop fed, grate discharge ball mills, operating in closed circuit with four 20-in. wet cyclones, equipped with 7½-in. vortex finders and 3-in. apexes. The circulating load is about 250 percent and the ball mill discharge is maintained between 66 percent and 68 percent solids.

Ball mills operate at 60 percent of critical speed; they are equipped with trommel screens to separate reject balls and tramp oversize from the pulp going to the cyclone feed pumps. The wet cyclones operate at a pressure of five to seven psi, and the overflow contains 30 percent of solids of which seven to eight percent is retained on a 65 mesh screen, and 50 percent passes through a 325 mesh screen.

The initial ball load per mill consisted of 25 tons each of 2-in., 1½-in. and 1-in. diam molybdenum steel balls, and make-up, consisting entirely of 2-in. balls, is added at the rate of 0.75 lb of steel per ton of ore ground. Grinding balls are stored in pits located next to the rod pit, but inside the building. Balls are unloaded from the pits by means of a magnet suspended from a monorail hoist and charged into a hopper, from which they are loaded into ball cars, hauled by the same tractor that hauls the rods, weighed on track scales and charged into the mills.

The overflow from all eight 20-in. wet cyclones in one grinding section is collected in a junction box, where sodium isopropyl xanthate and pine oil are added at the rate of 0.055 and 0.022 lb per ton of ore, respectively. Ethylthionocarbanate, at the rate of 0.017 lb per ton of ore, is added to the rod mill discharge.

From the junction box, the pulp flows to a distributor, which divides it equally between four flotation machines, each consisting of a row of 28 cells, 48-in. square, provided with mechanical agitation and supplied with air at 1.5 psi. Flotation of the sulphides takes place in a pulp containing 28 to 30 percent of solids and at a pH of 11, to produce a bulk concentrate and tailing for discard.

Bulk Concentrates Reground in 9 by 12-Ft Mill

The concentrates from each bulk flotation section are pumped to a 100-ft diam torque thickener, the underflow of which is controlled by means of two diaphragm pumps to maintain 45 percent solids. The thickened product is reground in a 9 by 12 ft overflow ball mill, initially charged with 50 tons of one-in. diam grinding balls, to which a make-up charge of one-in. balls is added amounting to 0.15 lb of steel per ton of original ore. These balls are loaded into a special bottom-discharge bucket, weighed on platform scales and transported, by means of the overhead crane, to the mill feed chute. The regrind ball mill operates at 66 percent critical speed and in closed circuit with five 10-in. wet cyclones fitted with three-in. vortex finders and 1⅝-in. adjustable apexes.

Water is added to the ball mill dis-

charge, to obtain 15 percent solids in the cyclone overflow. The operating pressure of the cyclones is kept around 15 psi, and it is possible to isolate one or two cyclones from the rest of the bank at times of low loading. One 20-in. wet cyclone, installed in the line feeding the thickener, permits the coarser fraction of the bulk concentrates to be sent directly to the mill, thus reducing the load on the thickener rakes and on the pumps. Milk of lime is added to the regrind ball mill, to raise the pH of the cleaner feed to 11.5, and pine oil is added to the cleaner feed at an average rate of 0.027 lb per ton of ore treated.

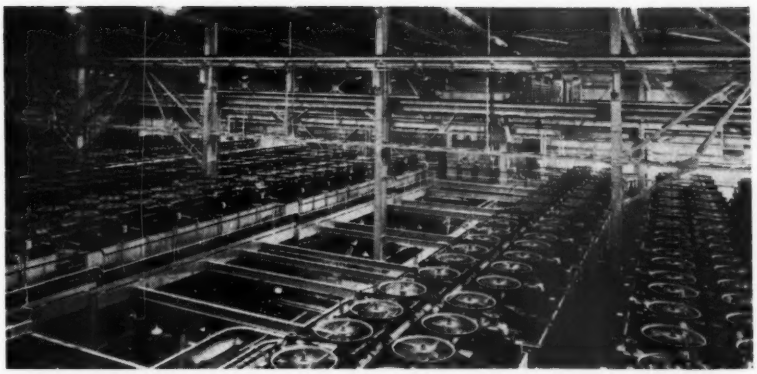
The regrind cyclone overflow averages 91 percent through 325 mesh, and it is pumped to two flotation machines, each consisting of a row of 28 cells, 48-in. square, arranged in the following order: six recleaner cells, eight cleaner cells and fourteen scavenger cells.

Cleaner concentrates are diluted with spray water to 15 percent solids and pumped to the recleaner cells, and the tailings from these return to the cleaners. The cleaner tailings flow to the scavenger cells, and the scavenger concentrates join the bulk concentrates for regrinding, while the scavenger tailings are discarded, together with the bulk tailings. About 30 percent of the combined tailings are treated in a 45-ft diam hydroseparator, followed by a 255-ft diam torque thickener, to recover water.

Seven Cleaning Stages in Molybdenite Section

The recleaner concentrates are thickened to 60 percent solids, repulped and thickened again in two 150-ft diam traction thickeners operating in series. Thickener underflow is controlled by two duplex diaphragm pumps per thickener. Thickened concentrates are conditioned in four 48-in. flotation cells, operating without air, before being treated in the molybdenite rougher flotation section, consisting of sixteen 48-in. flotation cells, of which only four are used to produce concentrates under present operating conditions.

Fuel oil and antifoam are added to the first conditioner cell at the rate of 1.25 and 0.20 lb per ton of concentrates treated, respectively. Nokes reagent LR-744 is added by stages to the last conditioner cell and to the first four banks of cleaners. Rougher tailings are neutralized with sulphuric acid, thickened in a 150-ft diam torque thickener to 60 percent solids and piped by gravity to the copper concentrates dewatering and loading station.



Flotation of the sulphides takes place in a pulp containing 28 to 30 percent solids and at a pH of 11

The rough molybdenite concentrate is first cleaned in three banks of cleaner cells operating in series: the first bank consists of four 48-in. flotation cells and the second and third banks, of four 32-in. cells each. Tailings from one cleaning stage flow to the head of the preceding stage, and concentrates are advanced countercurrent to the flow of pulp.

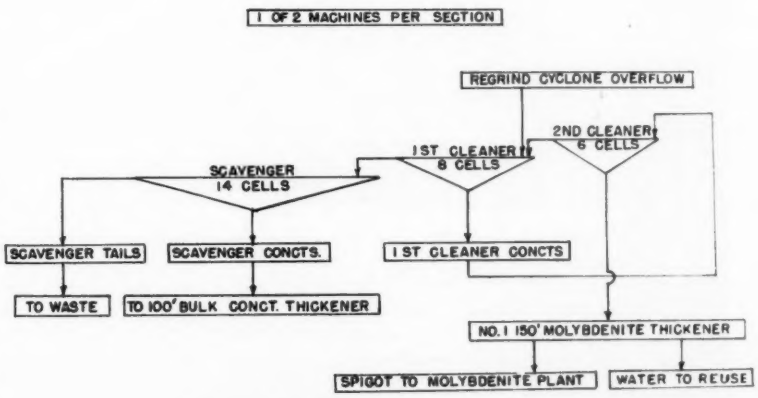
Provision is made to regrind the molybdenite concentrates from the third cleaning stage in a four by eight-ft overflow ball mill, operating in closed circuit with two 100 mm wet cyclones, before continuing with the cleaning operation, but in present practice this has been found unnecessary and the third cleaner concentrate is advanced directly to the fourth bank of cleaners. This consists of four 32-in. cells and it is followed by a further three cleaning stages carried out in the same manner in banks of two 32-in. cells each. Sodium cyanide is added in the sixth and seventh cleaning stages.

The final molybdenum concentrates are pumped to three storage tanks equipped with agitators and steam coils, where leaching with a hot cyanide solution can be carried out, if the copper in the final concentrate is too high. From the tanks, they are pumped to a filter with four 4-ft discs; filtered on the first two discs; repulped, and filtered again on the other discs. The filter cake is conveyed by a screw conveyor to a rotary dryer, from which the dried product is discharged into drums to be sampled, weighed and sealed up for shipment.

The copper concentrates treated in the molybdenum plant during the first six months of 1960 averaged 0.465 percent Mo; and the average assay of the molybdenum concentrates was 56.9 percent Mo with 0.17 percent Cu and 1.2 percent moisture after drying.

Solenoid-Operated Valves and Timers Regulate Flow of Reagents

In the concentrator, and to some extent in the molybdenum plant, the method used for feeding reagents to the circuit is based on the flow of liquids through an orifice, under a



Flowsheet of concentrator cleaner-scavenger section

constant head. Variation in the feed rate is achieved by introducing a solenoid-operated valve between the constant level head tank and the discharge orifice, and regulating the percent of the time the valve is open, by means of a timer working on a 30-second cycle.

All timers are located on a central panel, for easy control and adjustment and all solenoid valves and orifices are mounted on a stand next to the control panel, where their correct functioning can readily be observed. The orifices discharge into funnels or mechanical distributors, from which the reagents are piped to the various points of addition. With this system, feed rates remain fairly steady and only require checking three times per shift.

A similar system is employed for adding milk of lime to the grinding circuits, with the difference that, in this case, the solenoid operates a pilot valve which controls the admission of compressed air to an air-operated valve of the rubber sleeve type. The fact that addition of milk of lime occurs at full flow helps to prevent the pipes from plugging with sand. Pulp alkalinities are checked hourly by titration.

Automatic samplers are installed in the concentrator to cut samples of the flotation feed, bulk tailings, scavenger tailings and final concentrates from each section, and also a sample of the combined tailings for the whole mill. In the molybdenum plant, automatic samplers cut samples of the plant feed and tailings and of the molybdenum concentrates prior to leaching. The basic arrangement consists of a continuous cutter which works back and forth in the pulp stream, diverting a fraction of the stream to a second intermittent cutter, actuated by a timer. Pulp rejects from the secondary cutter are pumped back to the circuit by small vertical sand pumps, where they cannot be returned by gravity.

Dust Collection System Reduces Clean-Up

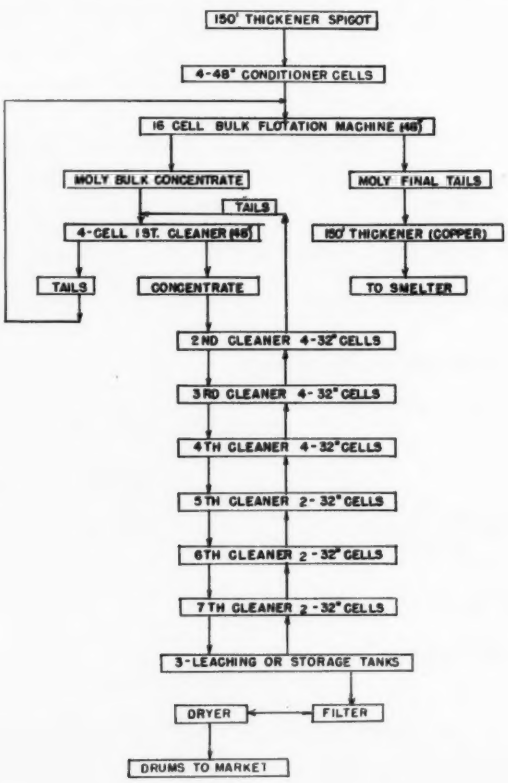
The problem of dust control received considerable attention in designing of the mill. Collectors are of the wet fan scrubber tower type; one 35,000 cfm collector is installed at the primary crushing plant; two 8400 cfm collectors, at the coarse ore storage bin; two 35,700 cfm collectors, at the secondary crushing plant, and two 14,400 cfm units, at the fine ore storage bin.

Each collector is connected by its own separate system of ducts and hoods to the points where dust is likely to be generated. Water sprays are provided at locations where the collecting systems are not applicable. The dust, in the form of a slurry, is collected in a sump in the secondary crushing building and pumped to the concentrator, where it is evenly divided between the four distributors at the head of the bulk flotation sections. The slurry from the collectors at the fine ore bins runs by gravity to the rod mill feed chutes. It is thanks to the efficiency of the dust collecting systems that the buildings are essentially free of dust, benefiting both operators and equipment and reducing clean-up requirements.

The efficient lay-out of equipment, the centralization of controls, and the provision of many automatic control features have made possible the operation of the mill with a relatively small labor force. Four laborers are required per shift in each of the two crushing plants. In the concentrator, there are four operators on the grinding floor, two checking reagents and alkalinities and watching the overall flotation, four attending the flotation and regrind sections, one at the return water pump station, one sampler and one clean-up man, making a total of thirteen. Four additional laborers are required, on day shift, to attend to the lime hydrating plant and to mix reagents.

Two operators are required, per shift, in the molybdenum plant and an additional two on day shift, when the filtering, drying and barrelling of the concentrate is done. Allowing for replacement personnel, the total strength of the mill operating crew for three shifts is ninety. The maintenance crew consists of forty repairmen and clean-up men and there are seven maintenance electricians.

A feature of the labor distribution that has proved of value is the allocation of men from the maintenance crew to the afternoon and night shifts. This allows many routine jobs to be done on these shifts, including the charging of balls and rods to the mills and the lubrication of equipment, thus reducing the demand on the cranes and materials handling equipment during the day.



Flowsheet of molybdenite plant

Good Control of Flotation Circuit Vital

Much credit for the satisfactory metallurgy achieved in the operation of the mill must go to the work done in the pilot plant in Potrerillos, where the feasibility of producing high grade concentrates, with good recovery, from samples of the Indio Muerto ore, was proved. The successful prac-

(*Continued on page 92*)

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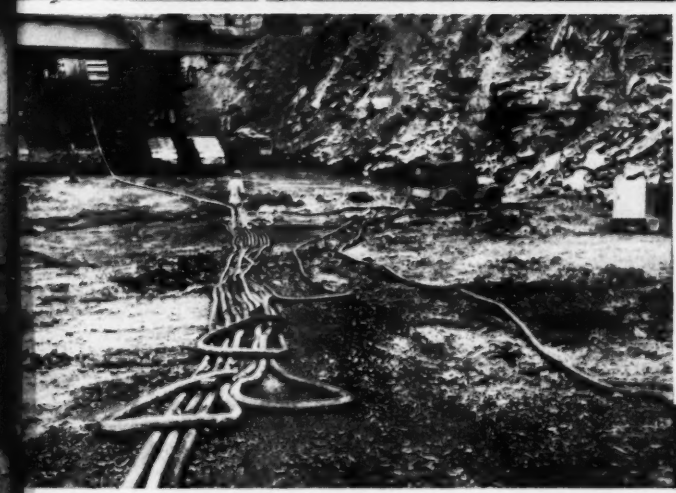

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LAS VEGAS REVISITED

Nevada Plays Host to Another Highly Successful AMC Convention and Exposition

DURING the week of October 10, some 8500 mining men and their ladies met in Las Vegas for one of the finest Mining Shows ever conducted by the American Mining Congress.

From the official opening on Monday morning until closing time on Thursday, the exposition halls, the outdoor exhibit area and the meeting rooms were crowded with interested visitors. Among them were leading legislators and Government officials, mining company executives, managers, operators, engineers, technical specialists, geologists and mill men, all of them coming to learn more about mining—its industry policies, and its new tools and techniques for more efficient production of the minerals needed to keep our Nation strong. The several committees organized by AMC Western Division chairman John C. Kinnear, Jr., general manager of Kennecott's Nevada Mines Division, left no stones unturned in their efforts to provide the best possible atmosphere for a fruitful meeting.

Miners came from every mineral producing area in the United States, and a large number made the trip from foreign lands, including Canada, Mexico, South America, Europe, Africa, Asia and Australia. Both the exhibit halls and the meeting rooms attracted keen interest throughout convention week, as delegates sought answers to the industry's problems.

These problems were thoroughly aired at a full schedule of sessions and conferences planned by an industry-wide Program Committee headed by national chairman Oscar A. Glaeser, vice president and general manager of western operations for U. S. Smelting Refining & Mining Co. The program covered important matters of national and industry policy, management concepts, taxes, public lands, labor relations, and the outlook for the various metals and minerals, as well as all phases of operations, including exploration, new techniques of open pit and underground mining, milling and metallurgy, and safety. To the speakers who worked hard to prepare and present their messages, to the chairmen and vice chairmen who presided at the sessions, and to the committee which organized the program, goes a large measure of credit for the success of the Convention.

OUTSTANDING EXHIBITS

THE Exposition, sponsored by the Manufacturers Division under the chairmanship of Albert E. Seep, president, Mine & Smelter Supply Co., surpassed even the high standards set at previous AMC Mining Shows. More than 130,000 net sq ft of exhibit space were used by 225 companies, to show the most varied and complete array of mining machinery ever assembled. From the intense interest shown in the displays, it was evident that the advance planning and effort put forth by the manufacturers paid off to the benefit of the whole mining industry.

Equipment was displayed for every size and type of operation, with representatives of the manufacturing companies on hand and anxious to share their specialized knowledge and to discuss cost reduction through the use of improved machinery. Many

items which had not previously been on the market were shown—thus giving mining men the opportunity to see equipment not to be found in any operating mine up to this time.

DECLARATION OF POLICY

AN industry-wide Resolutions Committee, headed by Kenneth C. Kellar of Lead, South Dakota, drafted and submitted to the convention a series of statements setting forth the views of the industry on major national policies which affect mining.

This "Declaration of Policy" affords a guide for the American Mining Congress in its day-to-day work on behalf of the industry, and serves as a medium for acquainting the public, Federal officials, and members of Congress with mining's problems and the policies needed to maintain efficient operations.

The "planks" of the policy declaration were presented at appropriate sessions of the convention, and were fully endorsed by the industry. The full declaration as adopted at Las Vegas appears on pages 31 to 37.

OPENING CEREMONIES

A WARM welcome was extended Mining Show visitors on Monday morning by Governor Grant Sawyer and Lt. Governor Rex Bell of Nevada and Mayor Oran Gragson of Las Vegas and President Raymond E. Salvati expressed the appreciation of the American Mining Congress for this hearty welcome and read telegrams of best wishes for a successful meeting from President Eisenhower and Vice President Nixon.

Also responding to the greetings of the Nevada leaders were Oscar A. Glaeser, chairman of the National Program Committee; Albert E. Seep, chairman of the Manufacturers Division; Jesse Core, chairman of the AMC Coal Division; and A. E. Millar, co-chairman of the General Committee for the Convention.

Chairman Kinnear, who presided during these ceremonies, then presented a host of Federal officials, members of Congress, and directors of the Mining Congress to the mining audience. After their introduction, President Salvati honored three United States Senators, who are voluntarily retiring from Congress on January 3, 1961 after distinguished careers totaling 72 years. In recognition of their dedicated efforts in behalf of constructive national mineral and fuel policies, he presented framed "Tributes of Appreciation" to Senators Thomas E. Martin of Iowa, James E. Murray of Montana, and Joseph P. O'Mahoney of Wyoming.

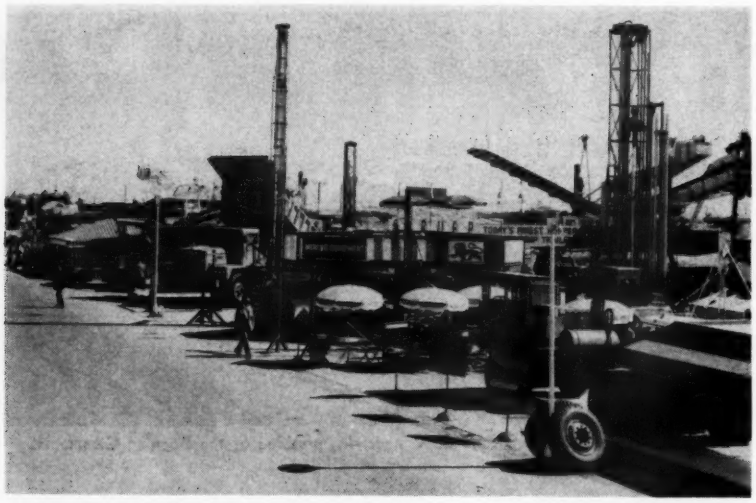
Western Division Chairman John C. Kinnear, Jr., presided at the Opening Ceremonies

Following these ceremonies, Senator Alan Bible of Nevada introduced spokesmen who discussed the minerals platforms of the Democratic and Republican parties.

AMC President Raymond E. Salvati presents Senator Thomas E. Martin with a "Tribute of Appreciation." Similar tributes were presented to Senators James E. Murray and Joseph C. O'Mahoney

Senator Frank E. Moss of Utah, representing the Democratic National Committee, said his party's platform pledges "immediate efforts toward establishing a realistic long-range minerals policy" to strengthen the domestic mining industry. "Nowhere has the Democratic-controlled Congress been more frustrated than in its efforts toward establishment" of such a policy, he stated. Last year Congress adopted a resolution asking the Administration to make recommendations to Congress for establishment of a long-range minerals policy, Moss said, but "to date, the Administration has seen fit to make no recom-

The Resolutions Committee, representing all segments of the industry, prepared the "Declaration of Policy" which was adopted by the convention



Attractive and educational displays provided a meeting ground between mining men and manufacturers' representatives

mendation."

He pointed out that the Democratic platform pledges research and development work on use of low-grade mineral reserves, especially oil shales, lignites, iron ore taconites, and radioactive minerals.

Senator Thruston B. Morton of Kentucky, chairman of the Republican National Committee, said the Republican candidates for President and Vice President "are determined to strengthen, to build up, the American mining industry, and the mining-based economy of the West." He cited various steps which the Republican Administration has taken to aid the economic status of minerals, including long-range minerals legislation proposed in 1957 and 1958 which "the overwhelming Democratic majorities in the Congress turned down."

Morton said Republican platform pledges include long-range minerals and fuels planning and programming and "continued support for Federal financial assistance and incentives under our tax laws to encourage exploration for domestic sources of minerals and metals, with reasonable depletion allowances."

Robert M. Hardy, Jr. is the new chairman of the Western Division, American Mining Congress

BOARD OF GOVERNORS LUNCHEON

THE Board of Governors of the Western Division of the Mining Congress met at a luncheon on Wednesday, with Chairman John C. Kinnear, Jr., presiding.

Members of the Board for the coming year, as nominated by the various State mining organizations, were unanimously elected, and Robert M. Hardy, Jr., president, Sunshine Mining Co., was elected chairman of the Division for the coming year.

The Board accepted an invitation to hold the next meeting of the Mining Congress in Seattle, Washington, September 11–13, 1961. Mr. Hardy and S. M. Strohecker, Jr., E. I. DuPont de Nemours & Co., of Seattle, promised a hearty welcome and a top-notch convention.

Jack H. How, president of Western Machinery Co., expressed the pleasure of the State of California that the 1962 Convention and Exposition are planned for San Francisco, September 24–27, 1962. His remarks were heartily endorsed by A. H. Shoemaker, vice president, Homestake Mining Co.

Invitations were received to hold meetings in Los Angeles in 1963, in Portland, Oregon in 1964, in Las Vegas in 1965 and in Salt Lake City in 1966. The Board instructed officials of the Mining Congress to study the proposed meeting sites and report back in due course.

Brief remarks were made by AMC President Raymond E. Salvati; Oscar A. Glaeser, chairman of the Program Committee; and Albert E. Seep, chairman of the Manufacturers Division.

Chairman Kenneth Kellar of the Resolutions Committee expressed the appreciation of the American Mining Congress to the city officials of Las Vegas, the various committee chairmen and to all of those connected with the convention and exposition for their efforts in making the 1960 Mining Show such a huge success.

SECRETARIES' BREAKFAST

MEETING at a breakfast Sunday morning prior to the convention, 24 representatives of State and District mining associations and staff officials of the Mining Congress held their 23rd annual discussion of problems of mutual interest. Presiding was Louis D. Gordon, executive secretary of the Nevada Mining Association, who also served as secretary of the General Committee for this year's Mining Show.

Several matters involving Federal and State public-land and mining laws were aired. These included Wilderness legislation, mining claims on subdivided stockraising homesteads, discovery requirements with respect to nonmetallic minerals, Federal inspection of metal mines, access rights, prediscovery protection to facilitate prospecting, lack of uniformity in State mining laws, and activities of the Western Governors' Mining Advisory Council.

GENEROUSLY MIXED WITH PLEASURE

THOSE who attended the Mining Show let few diversions stand in the way of the serious business of the Convention, but they also found time for social amenities and pleasures. On Sunday evening the Convention's social side got into full swing with a reception and cocktail party at the Flamingo Hotel. This will long be remembered as "the cocktail party that was rained out at Las Vegas." Originally planned for the outdoor gardens, the event was moved indoors when rain threatened—to prevent a dampening of either the spirit or the body as miners and their ladies greeted AMC officials and Committee Chairmen, met old friends and made new acquaintances.

A broad selection of star-studded shows at the leading "Strip" hotels offered almost unlimited high-quality entertainment throughout the week.

Special consideration for Mining Congress guests made it possible to secure reservations at as many of these outstanding shows as time allowed.

LADIES PROGRAM

A SPECIAL daytime program was arranged for the ladies who went to Las Vegas. On Tuesday, nearly 1500 of them attended an enjoyable luncheon and fashion show held at both the New Frontier and the Riviera Hotels. The fashion show, presented with the cooperation of several outstanding ladies shops, afforded an opportunity to view "what to wear" in this popular "sun city."

On Wednesday, special buses took the ladies to the beautiful home of Mr. and Mrs. Joseph W. Wells for a long to be remembered tea and reception. Many of the ladies also took in program sessions and viewed the exhibits at the Convention Center with great interest. And of course, large numbers of them took in the daytime sights in the vicinity of Las Vegas as well as the nighttime attractions of this famous resort center.

Two luncheon-fashion shows brought the ladies together at two of Las Vegas' fine resort hotels

TRIPS

TWO interesting and well organized trips were taken by convention-goers on Friday following the meeting. The first group consisted of two plane loads of mining men and ladies who flew to Ely to inspect the operations of Kennecott Copper Corporation's Nevada Mines Division. After landing, the visitors were taken by bus for a look at the hoist and compressor house at the Deep Ruth underground mine. This was followed by a trip to the Liberty pit where the mining operations and a modern skip hoisting installation were observed. The guests were treated to refreshments and an exceptionally fine lunch at the Hotel Nevada in Ely, and the tour then continued to the crushing plant and flotation concentrator at McGill. Moving on to the smelter, the group was shown the power plant, the recently completed suspended-arch reverberatory furnace, and the converter aisle. The final part of the trip included a stop at the data processing center in the comptroller's office.

A second group visited the operations of American Potash & Chemical Co., Stauffer Chemical Co., Titanium Metals Corp., and the Blue Diamond and U. S. Lime Products Divisions of The Flintkote Co. First stop, at the Apex operation of U. S. Lime, included a tour of an efficient limestone quarry and a modern, $2,000,000 kiln plant, with a capacity of 480 tpd of quicklime. This was followed by a trip to Basic Management, Inc. at Henderson. Here the Stauffer Chemical, American Potash and Titanium Metals facilities were examined. Total cost of the original plant was $135,000,000, but it has since been expanded. After a delicious barbecue lunch, Blue Diamond's open pit mine, plaster mill and wallboard plant were visited. The plant is one of the three largest in the world and has had its manufacturing capacity expanded 600 percent since operations started.

SEATTLE IN 1961

THE Mining Show of 1960 is now history. Las Vegas and the mining industry of Nevada went all out to make it a memorable convention.

Chairmen of committees in addition to those mentioned above included R. Julian Moore, general manager, Basic Management, Inc., and William Campbell, general manager, Federated Employers of Nevada, who were chairman and vice chairman, respectively, of the Publicity Committee; John C. MacDonald, resident manager, U. S. Lime Products Div., The Flintkote Co. and H. L. Waldthausen, Jr., works manager, Blue Diamond Co., chairman and vice chairman of the Trips Committee; William L. Kendrick, general manager, Tungsten Mining Corp., who served as chairman of the Welcoming Committee, supported by vice chairmen Paul Gemmill, general manager, Combined Metals Reduction Co., and D. F. McElhattan, district manager, Mine Safety Appliances Co. And special thanks, of course, go to Mrs. Joseph W. Wells of Las Vegas for her excellent work as chairman of the Ladies Committee and the warm hospitality shown in the reception at her home.

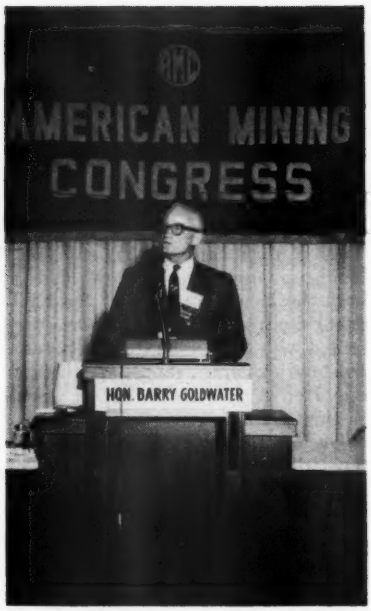
Miners are now looking forward to next year's convention, to be held in Seattle, September 11–13. Preparations have already begun under the leadership of the incoming chairman of the Western Division, Robert M. Hardy, Jr. Far-reaching changes now taking place will bring a new chapter of mining progress, as well as many new problems for the industry; but regardless of any uncertainties, mining men are sure of one thing—that they will want to make their plans early to be in Seattle next September.

Convention-goers arriving at Ely, Nev., for tour of Kennecott's Nevada Mines Division

THE SESSIONS

--- A Summary Of The Program

Highly qualified men from industry and Government presented their views and observations on both policy and technical problems in filled-to-capacity meeting rooms



Senator Barry Goldwater's address on Labor Relations was presented before a packed house

STATE OF THE MINING INDUSTRIES

SENATOR Howard W. Cannon of Nevada served as chairman at a session dealing with the State of the Mining Industries on Thursday morning.

J. Allen Overton, Jr., vice chairman, U. S. Tariff Commission, spoke on "Policies and Procedures of the Tariff Commission." He commented on some of the factors that are of fundamental importance as the Nation faces the task of regaining a favorable trade balance. Recognizing that recurring heavy deficits in international trade cannot be tolerated, the Executive branch of the Government is acting to stimulate exports through such "mechanisms" as the recently announced National Export Expansion program. The Tariff Commission's duties in all of this is to provide the facts needed by the Executive and Congress so that decisions relative to trade and tariffs can be made against a factual background. The Commission is also charged, Overton said, with carrying out "safe-guarding" provisions of trade agreements legislation which are designed to protect domestic industries against certain types of import competition as set forth in the statutes. These include setting "peril points" and use of the "escape clause."

Domestic mine production of copper for 1960 will probably about equal the record outputs of 1956 and 1957, according to Simon D. Strauss, vice president, American Smelting & Refining Co., as he reviewed the "State of the Copper, Lead and Zinc Industries." Outside of the United States, production of copper is headed for an all-time record. Domestic mine production of lead has not materially changed since 1959, while zinc production has been at somewhat higher levels when not interrupted by strikes. For the year, little over-all change in refined lead and zinc stocks is predicted.

The belief that low-cost imports is the basic problem of the domestic nonferrous industry, Strauss said, is an oversimplification. He pointed out that many other factors affect the demand for nonferrous metals, and that one hope for improving the domestic situation lies in searching out and promoting new markets.

Clark L. Wilson, chairman, Emergency Lead-Zinc Committee, who discussed the current lead-zinc situation, stated that estimates of 1960 and 1961 production both fall short of the Administration's targets and that the combined price for the two metals is still below that needed by the industry. Since a 1957 hearing by the U. S. Tariff Commission, which was followed by the establishment of quota controls, domestic mine production has decreased and metal stocks have increased. This indicates that quotas have not been effective and that the lead-zinc mining industry continues to be injured. Wilson said that the long-term solution lies in import tax legislation planned so that the domestic producer has a fair share of the market and can sell his production at a reasonable price. Proposals for legislation would provide a removable tax plus increased duties on manufactured items and would place control with Congress. He mentioned that research for new uses of lead and zinc is encouraging, and also that increased consumption is an integral part of the final solution.

C. F. Beukema, president, Oliver Iron Mining Division, U. S. Steel Corp., spoke on the outlook for the

iron ore industry. He said that there is an abundance of iron units in iron-bearing materials in the United States. However, he noted, there is "a great challenge in making these iron units acceptable at reasonable and competitive price-quality ratios. Through research and engineering, some low-grade ores are being converted into premium products. New and advanced methods of mining and processing and even the employment of automated techniques are being used to insure better quality control. These efforts cannot, however, do the whole job without cooperation from employes to improve efficiency and reduce costs, nor without a general recognition that no undertaking can prosper unless there is a satisfactory business climate." He concluded that "those who legislate and those who administer the laws must create and nurture a climate attractive to capital investment, if we are to improve our standard of living, preserve democracy, and 'Watch America Grow'."

Mining men divided their time between the convention sessions and the exhibit halls

Robert A. Learnard, vice president, Aluminum Co. of America, in considering the state of the light metals, called attention to the increasing size of the light metals family. Aluminum, he said, is still "head of the household," which includes magnesium and two other fast-growing members—titanium and beryllium. In general, he said, the outlook for magnesium is better now than it has been for several years, titanium appears to be on the threshold of a substantial growth period, and beryllium output this year is expected to reach record levels. Turning to aluminum, he pointed out that primary production capacity in the United States has more than tripled during the past decade. The past year has been a period of adjustment to this rapid expansion and to other recent developments, including the termination of major government stockpile contracts, the 1957–58 recession, last year's steel strike, and this year's business "plateau." These developments have tended to keep demand from increasing at its long-term growth rate, and have prevented the industry from making full use of its expanded capacity. The result has been an oversupply of metal and heightened competition. However, Learnard said, the outlook remains favorable for a resumption of the projected upward trend in demand.

The past, present and future of solid fuels was discussed by Walter F. Schulten, vice president, Consolidation Coal Co. He pointed out the great progress in mine mechanization, emphasizing coal's record of continual improvement in productivity and unmatched stability in price. In reviewing prospective markets, he predicted that total requirements for bituminous coal will exceed 600 million tons in 1975 and 700 million tons in 1980. However, he said, coal still has its problems, one of which is residual oil imports. It is the firm conviction of those in the coal business that only by adoption of a national fuels policy will the nation gain assurance that adequate energy supplies will always be available, particularly in the event of a national emergency.

"With few exceptions, nearly all of the industrial minerals—from the construction materials to specialty minerals—will be needed in greater supply in the next decade," according to Bernard J. O'Neill, Jr., geologist, Department of Earth Sciences, Stanford Research Institute. He explained that many known occurrences will be developed into proven reserves, and that there will be greatly increased research on the problems of exploration, mining, beneficiation, development of new uses, and marketing of these minerals. The projected growth patterns for the Western States, he added, indicate a substantial increase in industrial mineral production.

The next paper, entitled "Special Metals and Rare Earths," by Stephen Yih, vice president and general manager, Wah Chang Corp., was presented by Edmund F. Baroch, metallurgist of the company's Albany, Ore., Division. The discussion took a close look at tungsten, molybdenum, tantalum, columbium, magnesium, aluminum, yttrium, beryllium, zirconium, boron, hafnium, europium, gadolinium, samarium, vanadium, chromium and rhenium—for service in the fields of electronics, nuclear energy, and space exploration. It was pointed out that these metals will play an ever-increasing role in our future, but that development is slow at present because of a limited tangible market which makes private industry hesitant to engage in larg-scale research. Government assistance is needed he said, to encourage research, development, and production of these metals in order to insure their availability for the electronics, nuclear, and space industries.

"The strategic metal industry in the United States has reached, or will reach in the next few months, the production levels of 1939," according to S. H. Williston, executive vice president, Cordero Mining Co. "We are again the 'have not' nation in strategic metals that we were before World War II," he said. Two reasons, he pointed out, clearly explain the almost complete elimination of the strategic mining industry—(1) deposits of these metals are relatively abundant in some of the lower labor cost countries in the world, and (2) tariffs on strategic metals are either nonexistent or extremely low. A contributing cause, Williston charged, is the apparent policy of our Government to permit the complete elimination of this industry so long as the cold war continues. He concluded that it might be wise for producers of other metals to examine the precedent set by Government action in the strategics.

LABOR RELATIONS

TWO members of Congress and a corporation official addressed the Wednesday afternoon session on Laber Relations, with Oscar A. Glaeser presiding.

Senator Barry Goldwater of Arizona told a capacity audience that the vast economic and political power of labor unions stems from Federal

laws, which, he said, will not be changed "until an aroused citizenry demands that they be tempered down so that the public will not suffer from them." He added: "It's no more proper to have too much power in labor than it is to have too much power in management. And it is no more proper for labor unions to buy elections than it was proper for corporations to buy elections at the turn of the century."

The Arizona Senator suggested that industry-wide bargaining is a source of union economic power that should be outlawed, and he urged repeal of the provision of labor law that permits union-shop contracts. "I see nothing compatible at all about a man having to belong to anything in order to work," he said. "No man interested in mining has to belong to the American Mining Congress, yet all men interested in mining benefit from this group. The argument used of the free rider is a very weak one," he declared. Goldwater also urged strengthening secondary boycott prohibitions, on the basis that there is "nothing morally or legally right about involving a third person who is not involved in any way in a strike."

J. S. Parker, vice president, General Electric Co., warned that the failure of politically inclined union leaders to recognize the threat of foreign competition in world and domestic markets would impair the job security of their membership.

He urged management to develop employe concern in the welfare of the business. Employes should realize, he said, that wages are ultimately paid by customers, that inflated wages mean inflated prices, that employment security depends on opportunity to continue to produce at prices the customer will pay, that the gains accruing from increased productivity cannot all be given to the producers but must be shared with the customers, that a substantial percentage of the profits must be reinvested in the business, and above all that continued success of the business is essential for security of jobs.

Representative John H. Dent of Pennsylvania spoke on "Cooperation Between Labor and Industry." There is no room for cooperation between a selfish employer and an ambitious, unreasonable labor leader, he said. Reasonable men in both fields, Dent declared, know that on management's side the open road to cooperation has to be paved with understanding of the problems of the workers, and on the workers' side the road must also contain "the ingredients of sound construction, namely, a respect for the property and profit rights of management."

Cooperation plays a part in the passage of tax laws, Dent said. "If the burden of taxation is placed too heavily upon management, strangulation sets in and job opportunities diminish and sometimes disappear. On the other hand, if the burden falls too heavily upon the consumer or worker, the pinch is felt in the market place and again the results can be disastrous," he stated.

URANIUM

U. S. Atomic Energy Commissioner Loren K. Olson discussed the "Status of the AEC Uranium Purchase Program" at a Thursday afternoon session presided over by Eugene B. Hotchkiss, executive vice president, Vitro Minerals Corp., New York.

Olson said the long-term future of the uranium industry "remains bright and there will develop eventually a demand for nuclear fuel of such magnitude that the ability of the uranium industry to meet it will be severely taxed."

With respect to forecasting what the Commission's uranium purchases will be after 1966 (the end of the current purchase program, Olson said that "any guesses I might make would almost certainly be invalidated by the passage of time. The fact of the matter is that we cannot see clearly enough beyond 1966 to state now what our requirements will be."

William B. Murray, executive assistant to the president, Atomics International Div., North American Aviation, Inc., Canoga Park, Calif., spoke on "Meeting Energy Needs for the Next 100 Years." He predicted that, over this period, approximately 62 percent of our cumulative total energy requirement will be supplied by coal, 13 percent by a combination of oil and gas, 16 percent by uranium fuel, and 9 percent by hydropower and non-commercial sources.

By the year 2000 perhaps 25 percent to 30 percent of the electrical power generating capability in this country will come from nuclear sources, Murray said. "It appears," he added, "that the uranium which can be mined in the United States at today's price of around $10 a pound could supply the projected nuclear electric industry until about the year 2000."

GOLD, SILVER AND MONETARY POLICIES

CO-CHAIRMEN of the session on Gold, Silver and Monetary Policies were Merrill E. Shoup, president, Golden Cycle Corp., and H. B. Johnson, manager, Sunshine Mine, Kellogg, Idaho.

Dr. Elgin Groseclose, Washington, D. C., financial analyst and consultant, reviewed the current gold and silver situation. He said the miner of precious metals "can look forward confidently to a better relationship between costs of production and receipts for production, which means a better outlook for profitable production, and, hopefully, a stimulus to increased production." Basis for this view, he said, is "the acute and growing shortage of the precious metals and the increasing demand for them for both monetary and industrial purposes."

Industrial consumption of silver is now exceeding production, he said, and the effect of U. S. Treasury silver sales at 91 cents an ounce is "to put a ceiling on silver prices, and, in effect, to subsidize silver users."

As to gold, Groseclose said it is "in exceeding short supply and a rise in price is inevitable, either through currency revaluation or through forced and extraordinary deflation and contraction of currency and credit supplies."

Shoup and Johnson then discussed various aspects of Groseclose's remarks.

PUBLIC LANDS PROBLEMS

CHAIRMAN Wayne N. Aspinall of the House Interior and Insular Affairs Committee presided at a Tuesday morning session on Public Lands matters which featured discussions of proposed wilderness legislation, problems involved in the use of the newer exploration techniques, and developments under the multiple use laws.

Representative Aspinall praised the action of the 86th Congress in enacting some 66 public laws dealing with mining and public lands. He said the public land laws are vital to the mining industry, and praised constructive recommendations from the American Mining Congress and its members—which, he said, had played a substantial part in legislation during his six terms in Congress.

Russell H. W. Chadwick, exploration geologist of the Bear Creek Mining Co., Spokane, outlined the efforts of wilderness exponents to obtain legislation which would, to all practical purposes, bar mineral or other commercial developments in 10 percent or more of public domain lands. He said the wilderness proposals have the frightening general implication of pleasure before business. He said that

Congressman Wayne N. Aspinall of Colorado was chairman of the session on Public Lands

in a world in which peoples of other nations are fiercely competitive economically and militarily "it is frightening to hear it expounded that we have gone as far as we ought to go and that now we can afford to devote a large portion of our potentially valuable mineral land to recreation or to the escape of wilderness." He pointed out that the mining industry stands willing to cooperate with others in the use of the public domain but emphasized that there is no call for a wasteful "iron curtain" in the forests.

Also speaking on the implication of wilderness legislation, W. D. Hagenstein, executive vice president, Industrial Forestry Association, Portland, Oregon, told the Convention that the struggle is not over wilderness but a clash of philosophies. Proponents of the wilderness proposals, he said, would hastily dedicate millions of unexplored, unsurveyed, roadless acres of Federal lands as wilderness. On the other hand, opponents believe that wilderness dedication should be preceded by land-use studies which demonstrate that multiple use can be prohibited on suggested wilderness areas without adversely affecting the Nation's future.

He pointed out that the population trend is continually upward and that by 1980 the U. S. population will have risen to a quarter of a billion persons—70 million more than at present. This trend is the most forceful argument against creating blanket wilderness areas without comprehensive land-use studies, he said. He told the Mining Congress that multiple use of most of our land is the answer to wilderness proponents.

Under Secretary of Interior Elmer F. Bennett declared that the public lands are contributing much to the development of the West. He said the Department's program is to ensure that the public lands are meeting the demands of an expanding economy without destruction of their future usefulness—"development without exploitation, conservation without stagnation."

Speaking of mineral development of the public domain, Bennett declared that as our known mineral reserves become depleted the future of our domestic mining industry may well depend upon more intensive use of the new exploration techniques on public lands. The Interior Department believes that legislation is necessary to resolve the inadequacies of the Federal Mining Laws with respect to use of the newer techniques for mineral exploration, he said, and such legislation should embrace these general principles: (1) Larger areas would be committed to mineral prospecting than under existing laws, thus requiring minimum interference with other concurrent uses of the surface until such time as actual discoveries outbalance the value of other uses, (2) areas held should be reasonable in size and subject to aggregate acreage limitations, and (3) a reasonably short period of time should be established for the completion of exploration activities.

Charles F. Barber, vice president and general counsel, American Smelting & Refining Co., New York, N. Y., also spoke on the need for amending the mining laws to provide for use of the newer exploration techniques, and to afford "pre-discovery" protection. He said that the subject had been thoroughly aired throughout the industry, and had been the subject of comprehensive review by G. H. Ladendorff of Phoenix at the Rocky Mountain Mineral Law Institute. A great deal of work, he said, has been done by Ladendorff and a group of western land attorneys to hammer out a draft bill incorporating so far as possible the ideas of those who have been concerned with the pre-discovery problem.

Barber pointed up the issues that had developed in preparing the draft bill and said that it provides for (1) possessory rights based on the staking of an exploration claim, (2) a basic exploration claim of 160 acres with a limitation on the area to be held by any one owner in any one State of 5120 acres, (3) protection for the locator for five years, with work requirements increasing after three years (this period was provided to permit perfection of discoveries), (4) an annual labor requirement of $10 per acre during the first three years and $20 per acre during the fourth and fifth years, with expenditures chargeable to any claim presumed to be for the benefit of all claims in the group, and (5) giving the locator a choice of staking conventional claims as at present, or an exploration claim.

He said the proposed measure was under study by the Public Lands Committee of the American Mining Congress and that comments and suggestions as to the proposal were welcomed.

Edward P. Cliff, assistant chief, U. S. Forest Service, made it plain that the Forest Service favored multiple use of public lands and recognized the importance of mining on such lands. He said that the multiple use Act (Public Law 167) has brought the Forest Service and the mining industry into closer cooperation.

Edward Woozley, director of the Bureau of Land Management, also supported the multiple use of public lands. He described the operation of several of the land laws involving multiple use and declared "the ever increasing demands for our lands and resources by every segment of our rapidly expanding population makes single-purpose use an unsatisfactory and outmoded practice." He commended the cooperation of the mining industry with the Interior Department and urged its continuation in the future.

TAXATION

THE Tax Panel on Tuesday afternoon was presided over by Senator Thomas E. Martin of Iowa, who emphasized how much he has enjoyed

The technical program covered a wide range of subjects—from modern management concepts to "how to do it in the mine"

attending AMC conventions over the years. The current meeting, he added, would be the last one he would be able to attend as a U. S. Senator, as he had decided, after some 22 years in Congress, not to run for reelection this year. He made the point that unfortunately there are many members of Congress who are not fully aware of the special needs of the mining industry and the industry's importance to the national welfare, and that the industry must continue its efforts to educate the public and the Congress with respect to these problems.

Congressman Hale Boggs of Louisiana, a member of the Ways and Means Committee, discussed the tremendous work-load facing that Committee, and reviewed briefly some of the more important actions taken in the past year. He pointed out that no bill reducing percentage depletion has ever been reported by the Ways and Means Committee, and expressed the belief that the deduction is not seriously jeopardized in the immediate future. He said that the Gore amendment dealing with "cutoff points" for depletion, which originated in the Senate, was justified, and helped eliminate criticism of percentage depletion.

Boggs expressed the hope that two bills which he introduced but which failed to pass in the last session would receive favorable consideration next year—H.R. 5 and H.R. 7123. H.R. 5 would provide more workable rules for investment of American capital in foreign countries, and H.R. 7123 would allow the deduction of legitimate business expenditures for the purpose of influencing legislation.

Pointing out the heavy work-load of the Ways and Means Committee in connection with tariffs, Boggs stated that industry should not expect the Congress to solve problems of this type when the industry itself cannot agree on the proper answer.

Jay W. Glasmann, Assistant to the Secretary of the Treasury, discussed legislative activities generally, and depletion in particular. He recounted the many proposals which were introduced in the last session dealing with percentage depletion—many of them adverse—and indicated his belief that percentage depletion will continue to be the subject of legislative consideration.

Senator Wallace F. Bennett of Utah, a member of the Senate Finance Committee, was scheduled to speak but was unable to be present. His remarks were read to the group by Lincoln Arnold, chairman of the AMC Tax Committee, who also presented his own commentary on Senator Bennett's speech.

Bennett holds the view, applauded by industry generally, that depreciation policies must be further liberalized in order to stimulate capital investment so that we can achieve a continued growth in our economy—which he said is essential if we are to provide the jobs, the standard of living and the domestic strength which the Nation must have.

Arnold expressed the opinion that replacement-value depreciation is not politically feasible at the present time, and pointed out that the "reinvestment depreciation" proposal which has gained adherents in recent years is not subject to the criticisms which have been made of replacement value depreciation—since under the reinvestment method the taxpayer would not be permitted to deduct funds not actually spent.

TAX FORUM

ON Thursday Lincoln Arnold presided over a full-day's session of mining tax men. In addition to general discussion of technical problems affecting the industry, the group spent considerable time discussing recent developments involving cutoff points for percentage depletion. Charles Reinhardt, of Los Angeles, spoke on problems involved in the application of the "workback" or proportionate profits method of determining gross income from mining for percentage depletion purposes.

Arnold, assisted by AMC staff members Brice O'Brien and Larry Sherfy, led a discussion on various subjects, including the determination of the "property" which forms the basis for the depletion computation, depreciation, and the general legislative outlook.

MANAGEMENT TOOLS AND TECHNIQUES

E. I. RENOUARD, vice president, Western Operations, the Anaconda Co., served as chairman at the Management Tools & Techniques session on Thursday afternoon. Henry E. Swanson, assistant manager, Combined Metals Reduction Co., served as vice chairman.

"The Realities of Free Enterprise" was discussed by a man who has been associated with the electric industry for 34 years—E. M. Naughton, president, Utah Power & Light Co. He expressed concern over Federal Government moves toward assuming more and more responsibility for supplying electricity regionally—a responsibility previously resting in the hands of people operating in a free society. This has been done through the Tennessee Valley Authority, the Bonneville Power Administration, the Rural Electrification Administration, Southwest Power Administration and tax-privileged super-cooperatives. All told, these programs have cost the American taxpayer billions of dollars and provide subsidized power to a privileged minority. Naughton said that it has always been an enigma to him why municipalities, counties and states do not wake up to the fact that tax-free operations produce no tax revenues. He added that if those in business would dedicate themselves toward educating their own employes and people in general as to what is happening, they would make great strides toward solving, and maybe eventually turning around, the alarming trend toward a socialistic central government.

While the title of the next paper, "Research Scientist, the Care and Feeding of," is facetious, according to Jack W. Dunlap, president, Dunlap & Associates, Inc., the problem of effectively managing a group of researchers is serious indeed. He did not deal with the over-all problem, but rather with some of the personnel

and organizational problems. He posed several key questions to research managers for reviewing and evaluating a research activity, which with others must be answered if the past rate of growth in the mining industry is not only to be maintained but accelerated. Managers of research organizations, he said, must bring to bear upon problems the creative imagination and technical skill of highly trained men—unfortunately, the missing element in many corporations is imaginative audacity. Also, the administrator must recognize his role and aid the research man in performing his.

Sherrill A. Parsons, coordinating partner-Western Region, Booz, Allen & Hamilton, spoke on "What the Management Consultant Can Do for the Mining Industry." He observed that successful management depends upon maintaining staff services at optimum levels throughout the business cycle. When a company is unable to provide these services from within, it can still obtain them from qualified consultants. Problem areas where consultants can be helpful are those concerned with cost reduction and cost control, market studies, engineering and research, and personnel studies. Parsons emphasized that consultants only supplement management—that they do not replace it.

Walter H. Schwedes, Sr., application engineer-mining, General Electric Co., used slides to illustrate his talk on "Computers in the Mining Management System." He explained that the study of management systems has evolved certain basic concepts that can be represented schematically in "closed loop" form. High performance, technical and business equipments for years have been designed for "closed loop" behavior. These two systems, management and equipment, are so functionally alike that the same basic principles can be applied to their design and appraisal. It is, therefore, natural to integrate them into an equipped management system. Schwedes then told how computers can relieve humans in the management system of an ever-increasing burden. Computers, he said, can comprehend, judge, forecast, make decisions, and command, when equipped with reporting, communication, and automatic language translation equipment. Once placed in the well designed system, computers have true management worth in the control and growth of the business, its yield, and its profit.

The final speaker of the afternoon was W. Phil Herriott, director of Education and Training, United Air Lines, Inc., who covered "Changes and Challenges in the Managerial Function." He made four major points in his presentation: (1) the function of management changes, (2) management skills and attitudes suffer from obsolescense, (3) forces of change are complex and obscure to a point where we are frequently unaware of them, and (4) these changes which are going on right now create new challenges and new responsibilities for managers. In addition, he discussed what these challenges and responsibilities mean to individual managers and some of the things they can do to meet them. What do employes expect today? According to Herriott, good pay, many benefits and comfortable working conditions are high on the list. But they also expect more participation in decisions which affect them and more recognition of them as individuals. They also want full information, social acceptance and status. Managers, on the other hand, can benefit from a suggestion "that the consequences of the leaders' behavior should be evaluated in terms of the led." This would indicate that a manager should become more sensitive to the social and political currents operating within his organization.

INDUSTRIAL ENGINEERING SYMPOSIUM

A TUESDAY afternoon symposium under the chairmanship of Paul Dashine, president and general manager, Calumet & Uranium Divisions, Calumet & Hecla, Inc., was devoted to industrial engineering.

The first paper, "Survey of Industrial Engineering in the Mining Industry," was coauthored by R. M. Stewart, director, Mining Research, who presented it, and S. W. Hurlburt, senior research engineer, the Anaconda Co. To lay a foundation for discussion of the various aspects of industrial engineering, they made a survey of its use in mining. The survey involved 23 operations—14 in the United States and 9 in Canada—and indicated the type and scope of work performed, the type of personnel used now and needed in the future, the importance of line cooperation, and the part consultants play. It also pointed out that the mining industry has been slow to use this cost-cutting tool, and that even where used, its full potential has not been realized. In conclusion, the authors emphasized that industrial engineering can only reach its maximum effectiveness when it is actively used by management to help manage.

Benton Boyd, manager, U. S. and Lark Mine, U. S. Smelting Refining & Mining Co., concentrated on underground standards, based on his company's experience. Its search for more efficient methods of operation led to study and analysis of all phases of the mining operations. Initiation of cost-reduction programs resulted. Boyd observed that a work measurement program should be developed from initially engineered studies. Careful periodic evaluations of these studies, combined with extreme flexibility in approach, will contribute greatly to the over-all improvements realized. He also emphasized that the main purpose of a standard is to measure manpower productivity. The program, he said, must never be used as a means to "speed up" work or for establishing unreasonable goals.

The next speaker, M. J. O'Shaughnessy, assistant general manager, Nevada Mines Division, Kennecott Copper Corp., delved into the subject of cost controls. He pointed out that effective cost control requires a realistic and continuing review of actual production and its costs compared with standard production and standard costs for the given conditions. To accomplish this his company used its industrial engineering department to install and keep current an effectiveness reporting system. In reviewing the developments of this system, he credited industrial engineering with playing a major role in investigating, planning, organizing, implementing, and maintaining this important tool for current cost control.

"Industrial Engineering as Used in Maintenance by Climax Molybdenum Co.," was the subject of the paper presented by Charles A. Cleeves, assistant mine superintendent of the company. The methods and equipment section of the company's engineering department was started in April 1957, and consulting services were used to help establish the program. The purpose of this section is to establish work standards for maximum practical coverage of the plant through use of time studies and other industrial engineering techniques, and to improve methods and equipment for the Climax operations. Cleeves spelled out some of the risks connected with establishing an industrial engineering program in maintenance. Tracing his company's progress to date, he noted that the biggest gains are from time-study work. Considerable benefits have been gained

by the maintenance supervisors thinking in terms of time it will take to do a particular job, he explained, and they are taking greater care in organizing and scheduling their work.

The final speaker of this symposium was Meredith Smith, staff manager of Industrial Engineering, International Minerals & Chemical Corp., who discussed "Operations Research in the Mining Industry." He emphasized that better results can be achieved on large scale problems through the analysis and mathematical logic employed in operations research than by standard mining and industrial engineering techniques—then went on to illustrate his point with a typical type of problem on which O.R. has been used at IMC's potash operation in New Mexico. He reviewed the three basic types of models used in operations research, plus the other major ingredient—that the solution is oriented toward the optimum course of action.

SAFETY AND HEALTH

A TUESDAY afternoon session devoted to the science of making the mining industry safer for its labor force was presided over by S. S. Goodwin, vice president, New Jersey Zinc Co., who was assisted by vice chairman John W. Warren, chief ventilation and industrial hygiene engineer, the Anaconda Co.

Speaking on "Radiation Control in Uranium Mining and Milling," Robert G. Beverly, administrator, Radiation Controls, Union Carbide Nuclear Co., presented background information on the radioactive characteristics of uranium, and went on to give data on half-lives and the abundance in nature of various isotopes, as well as types of decay and their relation to radiation control work in uranium mining and milling. He described the equipment required for conducting external radiation surveys, for air sampling and liquid effluent sampling and assaying. He discussed the significant phases of radiation control programs in the mines and mills. Such programs include radon gas control in mines, external radiation in mines, the measurement and control of dust in crushing and sampling plants, control procedures in wet processing plant areas, the significance of control of airborne uranium concentrate in the mill, and disposal of tailings and liquid effluents. Control measures required to meet Federal compliance regulations were particularly emphasized.

Bernard W. Carey, assistant superintendent, Pickands Mather & Co., gave an up-to-date account of fighting underground fires with foam producing detergents. He described how this technique should be applied, its affect on a fire area in a mine, and the types of mine fires for which it is an effective fire-fighting tool. Carey further described tests conducted by the U. S. Bureau of Mines on underground coal fires in which this technique had been consistently successful where the foam contained over five cc of water per cu ft of foam. He urged the industry to become familiar with this new tool and to develop it to fit the requirements of individual properties.

Safety in open pit blasting was the subject of a movie and talk by Emery C. Olsen, supervisor of mine inspection, Columbia-Geneva Steel Division, U. S. Steel Corp. Based on the operations of the Columbia-Geneva Steel Division, the presentation stressed the safety precautions associated with high explosives, and particularly with ammonium nitrate-fuel oil mixtures. The speaker pointed to the virtual elimination of injuries associated with secondary drilling and blasting through the use of mobile drills, and the close engineering control which leads to more effective use of explosives and contributes to improve safety.

The remainder of the session was devoted to an hour-long panel on "Dust Control in Mining Operations," moderated by E. P. Pfleider, head, School of Mines & Metallurgy, University of Minnesota. Panelists included Ronald E. Bales, assistant chief, Occupational Health Field Station, U. S. Public Health Service; L. B. Berger, chief, Division of Accident Prevention & Health, U. S. Bureau of Mines; Howard L. Hartman, head, Department of Mining, Pennsylvania State University, and Frank J. Laird, Jr., assistant chief ventilation and industrial hygiene engineer, the Anaconda Co. After briefly reviewing the extensive research of the U. S. Public Health Service over the past 40 years in the field of dust diseases, Bales described the current studies at metal mines throughout the country which were initiated in 1958 and will continue until the latter part of 1961. The first phase of the study consists of a medical examination of all employes in various sizes and types of metal mines on a voluntary basis. As of September 30, 1960, chest X-rays and medical and occupational histories had been completed on 10,026 employes of 38 different metal mines in the United States. Information from most of these examinations has been entered on punch cards for tabulation at the end of the examination phase of the program, and it is expected that a preliminary report may be assembled and released prior to September 1, 1961.

Berger discussed this program in somewhat more detail, stressing the importance of a fixed policy in the conduct of the investigation to all who might be concerned in, or affected by its results. He quoted several pertinent points concerning the types of technical data to be obtained, which stressed the security of the information developed and the prohibition against interference or usurpation of any powers vested in State authorities. Berger commended management, labor and various Government agencies for their excellent cooperation, observing that such coordinated effort should provide a sound basis for attacking any phases of the problem that remain to be solved.

Recognizing that commendable results have been achieved by the mining industry in the elimination of some individual hazardous dust conditions underground, Hartman pointed up the need for simultaneous control, within prescribed limits, of the quality, quantity, and temperature-humidity of the air on an over-all basis throughout the complete operation in order to guarantee satisfactory environmental conditions for mine workers. He said that simultaneous control would lead not only to improved working conditions, which would induce greater productivity, but also to more efficiency in the air conditioning system itself.

Laird discussed the practical aspects of dust control, pointing out that a full knowledge of ventilation is only the first essential in solving any dust control program. Principles of rock wetability, and of dust capture, transport and retention must be applied in many mining applications. He concluded that continuous dust surveys, followed up by positive action can produce a desirable underground environment.

EXPLORATION AND GEOLOGY

JAMES BOYD, president, Copper Range Co., opened the technical phase of the program by presiding over the Exploration and Geology session on Tuesday morning. Assisted by Roger H. McConnel, chief geologist, the Bunker Hill Co., he first introduced John L. Mero, research engineer, Institute of Marine Resources,

Several symposiums and panels covered subjects of specialized interest

Department of Mineral Technology, University of California, who spoke on "Mineral Resources on the Ocean Floor." Mero described the interesting work now taking place in exploring (the major 70 percent) of the surface of the earth which lies beneath its oceans. Much of this exploration is done with cameras. Minerals found to date include: manganese, cobalt, nickel, copper, and fine grained unconsolidated deposits of other industrial minerals in relatively pure state. Mero's remarks were the basis for a full length article published in the October issue of Mining Congress Journal.

A new mapping program being undertaken by the U.S. Geological Survey was revealed by Philip W. Guild, chief, Base & Ferrous Metals Branch, of the Survey. It consists of locating the deposits of individual metals and nonmetallic minerals in the 48 conterminus United States. These maps are reproduced as film transparencies for direct comparison with each other and with the geologic and tectonic maps to assist the industry in discovering additional ore bodies and districts. The speaker described these maps as only the first step toward compilation of maps that will portray the spatial and temporal relationships of deposits to geologic and tectonic features of broad regions. Several of these maps were on display in a special exhibit in the Exposition Hall. This project is part of a worldwide effort partly sponsored by the International Geological Conference, which has formed a Commission for making a geological map of the world.

Karl J. Springer, president, Leitch Gold Mines, and of Highland Bell Mining Co., both of which operate in Canada, told his audience how a small mining company can pursue mineral exploration. He reviewed the several steps which must be taken to find attractive areas for exploration and to establish mineral reserves in sufficient quantities to proceed to develop a mine. Springer then gave some typical exploration cost figures indicating the amount of money that a small mining company must be prepared to spend in order to do a good job of exploration, pointing out that in most cases the capital requirements are likely to be too large for any one company. To overcome financing difficulties the speaker showed how, by the syndicate method, it is possible for a number of companies to band together into a partnership, enabling them to enter into several exploration operations and to "spread their bets." The parties to the agreement decide jointly on the various stages of exploration to be carried out. If the exploration project meets with success, a company is formed. Further financing can then be provided by the sale of treasury stock.

Speaking on "Geologic Reconnaissance of Large Areas Leading to Economic Appraisal," E. E. Thurlow, chief mining geologist, Northern Pacific Railway Co., said that large scale exploration for mineral deposits calls for the employment of the most up-to-date prospecting methods available, including the use of aerial photographs, geochemical prospecting and geophysical surveys. Thurlow described a project which his company is undertaking to evaluate a 2500 sq mile area in Montana in which Northern Pacific has a substantial ownership. He discussed the eight stages planned for the completion of this program, and while it has reached only the fifth stage, that of geochemical prospecting, he stated that his company's approach appears to be sound and that the progress to date has been very satisfactory. Possibilities for mineral discovery, he said, are potentially greater as the project proceeds to geologically more favorable areas.

In discussing "A Large Company and Worldwide Exploration," Glenn C. Waterman, chief geologist, the Anaconda Co. (Canada) Ltd., pointed out that a large metal mining company usually plans its broad over-all exploration program after an analysis of the present and estimated future demand, supply and economics of the common and rare metals as integrated into the company's reserves and desire future competitive position. Successful large company, worldwide exploration results when geological ideas, tempered with political and business considerations and directed by short and long-term company requirements, are a basis of continuing programs, Waterman said. Large companies will usually assume greater exploration risks than small companies, Waterman concluded, when the targets envisioned are sufficiently large to warrant expensive programs and because immediate success may not be a prerequisite.

Evan Just, head, Department of Mineral Engineering, Stanford University, presented a short discussion of Waterman's talk. He pointed out some of the difficulties of forecasting future demands for metals or predicting future political climate in any foreign country—or in the United States for that matter. Just also pointed that, while he hopes that the elaborate scientific procedures now being utilized are successful, he feels that only a small minority of the mines proven in the last five years were true scientific finds. These methods, he said, can be recommended as the way we ought to work when we can, and as a routine which has to be practiced in order to improve, but valuable minerals would be scarcer or more expensive today if we were wholly dependent upon scientific prospecting to find the mines.

Brisk discussion from the floor followed the presentation of the formal papers and pointed up a number of varying viewpoints on the subjects discussed.

UNDERGROUND MINING

THE first of two Underground Mining sessions got under way Wednesday afternoon under the chairmanship of James S. Westwater, vice president-mining, Cleveland-Cliffs Iron Co., with L. W. Casteel, assistant division manager, St. Joseph Lead Co., assisting as vice chairman.

Ingvar Janelid, professor of mining, Royal Institute of Technology, Stockholm, Sweden, presented a paper on "Mining Huge Ore Bodies in Sweden," which dealt with the iron ore operations at Kiruna, Malmberget, Grangesberg and Strassa. Sub-

level caving, he said, is at present the predominant mining method, but block caving will probably be adopted in an increasing degree, especially in connection with deep level operations. He described drilling and blasting practices in considerable detail along with a number of recent improvements in drifting, raising, and haulage. He also discussed the use of automation, television, personnel training, applications of data processing machines and new programming techniques for more efficient production.

"Developments in Large Borehole Drilling," was the subject of a talk by H. Eugene Mauck, vice president —operations, Freeman Coal Mining Corp. D. C. Ridenour, general supt., Olga Coal Co., collaborated with Mauck in preparing the paper which described Olga's experiences in drilling seven circular boreholes—from 30 to 76 inches in diameter—over a period of eleven years. Purpose of the holes was to provide shafts for ventilation and emergency escapement. The several drilling methods used, with costs, were described in detail.

James R. Gronseth, mechanical engineer, Inland Steel Co., described a conversion from conventional drum hoisting to a single-rope Koepe friction hoist system to solve a problem of removing ore beneath the depth limit of existing hoists. He reported that the Bristol mine shaft has been deepened by 250 ft and that hoisting capacity has increased some 35 percent. Experience so far indicates that the company can still go another 500 ft deeper using flattened strand rope.

Norman Visnes, supt., Galena Unit, American Smelting & Refining Co., reported on a shaft renovation job to overcome a number of serious limitations; namely, (1) a small shaft cross-section in heavy ground, (2) a slow-hoist, pulling ore from 4000 ft and (3) a short headframe. Improvements to date include the use of light-weight skips and cages, flattened strand hoist rope with conductor cores, improved rope maintenance, and installation of closed circuit television. Management feels that many more problems will arise in the future, but is confident that they can be overcome through further improvements.

William H. Harrison, Jr., general mine supt., Aluminum Co. of America, in his paper, "Slusher Operation in Narrow Veins," told about a modification of his company's shrinkage stope operation to overcome ore hang-up during the drawing operation. Harrison's complete text was published in the October issue of the Mining Congress Journal.

On Thursday morning, S. K. Droubay, vice president and general manager, United Park City Mines Co., was chairman of the second session on Underground Mining. He was assisted by vice chairman Donald T. Delicate, who is assistant manager of Homestake Sapin Partners.

"Practical Use of Rock Mechanics" was the title of a talk by Seth D. Woodruff, civil engineering associate, Department of Public Works, City of Los Angeles. Woodruff said that stresses which cause fracture and collapse of rock structures are induced by realignment and concentration of the pre-existing ground stresses. He discussed the structural behavior of ground around mine workings, tunnels, and other subsurface excavations and described methods for strengthening and utilizing natural ground structures. He also covered some applications of yieldable arches as well as methods for destressing stope faces and coal pillars.

A recent equipment installation at the Iron King Branch of Shattuck Denn Mining Corp. was discussed by Bee R. Waples, chief engineer, in a talk entitled, "Alimak Raise Climber." The full text of Waples' prepared paper is carried as an article in this issue on pages 42–46.

D. W. Pringle, manager and Herbert Shuttleworth, mine superintendent, Britannia Division, Howe Sound Co., collaborated in preparing a manuscript describing "New Drifting Methods at Britannia Mine." Shuttleworth, who presented the paper, said that early in 1959 the company decided to undertake major exploration that would include driving a 5000 ft long, 7 by 8½ ft exploration drift. Major equipment items for this project were a six-car train loader for handling a six-ft round and a five by twenty ft long flat deck drill jumbo. He gave complete accounts of the drilling and mucking cycles and said that the rate of advance in July was 2.87 ft per man-shift. Final costs including indirect on labor, steel, bits and drill repairs equalled $29 per ft.

Since the summer of 1958, International Minerals & Chemical Corp. has been conducting tests in the use of "Underground Ammonium Nitrate Blasting" at its Carlsbad, N. M., potash operations, which was the subject of a paper by Ben T. Phillips, Jr., and Adolph V. Mitterer, mining engineers with IMC. Phillips, who presented the paper, said that as a result of the studies, a useful new technique for underground blasting has been developed—one that has been found to be safe, effective and economical. It was found that ammonium nitrate in small diameter blast holes can be detonated reliably, and that bulk ammonium nitrate has superior fume characteristics when primed with a dynamite which also has good fume characteristics. Continuing test work is principally concerned with determining the optimum positioning of the primer in the hole and with ammonium nitrate fuel oil mixing procedures.

Studies resulting from the Ranier underground nuclear detonation in 1957 indicate the possibilities for "An Application of Nuclear Explosives to Block Caving Mining" as outlined in a joint paper by W. G. Flangas, mine superintendent, Reynolds Electric & Engineering Co. and L. E. Shaffer, professor of mining, University of California. Flangas presented the paper and stated that in the Ranier shot, a 1.7 kiloton detonation collapsed and fractured more than 500,000 tons of rock. This suggested that a retreat system of block caving could possibly be used to extract an ore body fractured by a series of nuclear detonations. The main working level would be driven prior to detonation. Post-shot work would involve repair and clean-up in the working level drifts and development of finger raises into the collapsed zone for ore withdrawal.

UNDERGROUND DRILLING SYMPOSIUM

CLAUDE O. DALE, assistant general manager, Chemicals & Metals Div., Eagle-Picher Co., presided at a special symposium sponsored by the AMC Underground Drilling Committee on Thursday afternoon.

J. H. Dewey, drilling research engineer, International Nickel Co. of Canada, Ltd., was the first speaker, presenting a complete story of "Underground Drilling at Inco." He gave a full account of the program for testing and selection of equipment at Inco's Sudbury Division, stating that steel and drills are under constant test in stations established for this purpose at one of the mines. Test procedures are designed to eliminate outside variables affecting performance. Inspection and maintenance of rock drills, an important phase of the program, were discussed in detail. Each mine, Dewey said, has a central repair shop on surface and several stations strategically located underground. Information developed by the test program has resulted in proposals for improved equipment design, which have been accepted by

manufacturers. In addition, new mining practices have been developed and put into operation as a result of the tests. Dewey said it has been apparent from his company's drilling studies that there are still vast opportunities for improvement in underground drilling equipment and methods.

An interesting panel on Drilling and Maintenance Practices followed next, with F. J. Haller, consultant, North Range Mining Co., serving as moderator and R. W. Persons, manager, Drill Steel Div., Crucible Steel Co. of America, and Chairman of the AMC Underground Drilling Committee, serving as co-moderator. Three speakers from operating companies presented introductory discussions, followed by enthusiastic discussion from the audience. Raymond Stewart, chief industrial engineer, Climax Molybdenum Co., introduced the discussions on "Scheduled Maintenance"; E. B. Olds, mine superintendent, the Bunker Hill Co., covered "Overhaul and Repairs," and William C. Campbell, assistant mine superintendent, Homestake Mining Co., discussed personnel considerations in drilling and gave some pointers for improved underground drilling techniques.

The floor discussion brought out such matters as the pricing policies of manufacturers, technical aspects of optimum air pressure, point at which a drill should be replaced, and assistance that manufacturers can give in helping an operator set up a preventive maintenance program. Campbell discussed the help that manufacturers can give in training miners through demonstration programs, pamphlets, posters, etc., and inquired as to whether a training film would be worth while, and who should make it. Many highly significant observations were made by both operators and manufacturers in the audience during the ensuing discussion period.

OPEN PIT MINING

THE first of two sessions on Open Pit Mining was held on Tuesday afternoon. Robert J. Linney, president, Reserve Mining Co., and Willis H. Wamsley, mine superintendent, U. S. Borax & Chemical Co. served as chairman and vice chairman, respectively.

Julian A. Fuller, superintendent of surface operations, and J. R. Krause, chief engineer, of the Bauxite, Ark., operations of Reynolds Mining Corp. collaborated in preparing a talk entitled, "Reynolds' Open Pit Mining of Bauxite in Arkansas." Fuller, who presented the talk, described a three-panel system of stripping and mining which provides operating flexibility and permits maximum selectivity of grades of ore with a minimum of stockpiling. The system consists of stripping one panel with draglines while mining is accomplished with draglines and shovels on top of the ore in the other two panels. Overburden in the current mining area averages about 95 ft in thickness with a maximum of 140 ft and overlies an ore body that varies from 5 to 40 ft in thickness.

The program covered all phases of operations; the speakers were top authorities in their fields

The tragic death of the next scheduled speaker, R. Y. Jensen, assistant chief engineer, M. A. Hanna Co., in an airplane crash while enroute to Las Vegas profoundly shocked the convention. His prepared talk, "Maintenance of Open Pit Equipment," was presented by B. M. Andreas, manager of Minnesota Mines, the M. A. Hanna Co.

Andreas said that timing and time must be considered in every operating decision because accelerated programs seldom permit the best planning and often upset carefully established practices. He stated that proper attitude, pride in operation and concern for equipment are vital to good maintenance, and that the attitudes of the foreman and those under him usually reflect the attitudes in the top echelons of management. He also pointed out that parts and tool inventories, shop working conditions, and many intangibles are factors of good maintenance.

Charles L. Boise, assistant superintendent in open pit mining and strippin, Isbell Construction Co., discussed Jensen's paper. He said that the proper location of shops, power and water supply and service centers in relation to the open pit mining operation is a highly important step toward efficient and productive operation; that layout is one of the prime factors in an operation, where minutes or even seconds means the difference between profit and loss.

Recent advances in heavy equipment design and employment of new tools and techniques for stripping overburden were discussed by J. V. Otter, engineer-special services, Morrison-Knudsen Co., Inc., in a talk entitled, "Economics of Various Methods of Overburden Removal." The type of equipment to be used is dictated by the quantities of overburden to be removed and the operating conditions to be met, but no two situations are identical. Suitable tools are now available for almost any conceivable earth moving job.

"Economics of Large Tires for Earth Moving Equipment" was the topic discussed by G. E. Danby, manager, sales development, Euclid Division, General Motors Corp. According to Danby, one of the most crucial factors affecting haulage costs is tire life and as larger capacity haulage units are utilized, this becomes more important. He pointed out some of the means for improving tire life and discussed tires designed to alleviate extreme heat problems. These include semi-highway tires, heat and cut resistant tires and shredded wire tires.

Walter C. Lawson, vice president and general manager, Phelps Dodge Corp., and Neil O. Johnson, operations manager, Foote Mineral Co., served as chairman and vice chairman, respectively, of the second Open Pit session on Thursday.

The first speaker was Roy Coulson, division superintendent, Vitro Minerals Corp., who talked on the "Open Pit Operations in the Gas Hills Area of Wyoming," a district which has developed into an extremely active mining area in the short span of seven years. Coulson's talk was the basis for the article on pages 54–56 of this issue.

"Scientific Techniques in Control of Open Pit Slopes," were discussed by Adolph Soderberg, consulting mining engineer, Western Mining Divisions, Kennecott Copper Corp. After pointing out the great economic im-

portance of properly designing slopes in large open pit mines with the ultimate objective of making the steepest safe slope possible, so that ore can be recovered with the least amount of stripping, the speaker analyzed certain factors which caused slides and told about experiences of his company concerning costly failures of open pit slopes. Soderberg stated that new techniques using soil and/or rock mechanics may provide important design aids for solving slide problems. Kennecott first approached the problem from a soil mechanics standpoint, and concluded that the application of soil mechanics is limited to slopes composed of soil, or to slopes in active slide areas where the sliding rock mass possesses properties similar to soil. Accordingly, a new approach has been undertaken involving a statistical evaluation of the rock structure in a pit slope. He went on to review all of the background and previous work done in this field, and concluded with a short discussion of the objectives of Kennecott's new program.

Edward B. Connors, mining engineer, Permanente Cement Co., described four cement quarries operated by his company under widely varying conditions. At the Permanente quarry near San Francisco, which produces about two million tons of cement rock per year from a geologically complex deposit, selective mining is facilitated by use of two primary crushing plants, each discharging into large stock piles. Rock from these primary stock piles is blended through the secondary crushing plant into three large secondary stock piles. The Cushenbury quarry in the Mojave Desert produces both metallurgical and cement grade limestone from a single deposit by selective mining. The Bellingham quarry, near the Canadian border, is being converted from a single high-face to a bench plan of operation. The most interesting phases of this operation result from the severe weather conditions prevailing in the area. Connors went on to describe plans for a new operation in Hawaii, where cement rock will be produced by a simple benching method from a relatively soft coral deposit which requires no blasting.

"New Developments in Initiation of Blasts in Mining," was the title of a talk by H. J. Poel, manager, Technical Service Section, E. I. du Pont de Nemours & Co., in which he discussed the use of low level detonating cord in low noise level trunk lines for the open pit mining, quarrying, and construction industries. This detonating cord is being used in many open blasting operations, where vibrations and air blast are problems, he said, adding that accessories have been developed for use with it to provide delay intervals of either 10 or 15 milliseconds, or any combination of the two. By greatly reducing the noise from a blast, the probability of vibration complaints is also reduced, because the two are often confused in the minds of the complainants. Poel concluded by pointing out the importance of the research effort by the explosives industry in helping its customers solve their problems.

The final paper of the session, "Innovations in Ammonium Nitrate Fuel-Oil Blasting Mixtures," presented by Donald M. Stromquist, technical representative, Coal Chemical Sales Division, United States Steel Corp., was published in full in the October issue of Mining Congress Journal.

GENERAL OPERATING PROBLEMS

WESLEY P. GOSS, president, Magma Copper Co., presided over the Tuesday morning session on General Operating Problems. The vice chairman was John Bley, vice president, American Chrome Co.

A capacity crowd heard Paul D. Bybee, of Freeport Sulphur Co. discuss "Freeport's Offshore Sulphur Property at Grand Isle." Bybee, who is general superintendent at the Grand Isle mine, said that this $27 million project in the Gulf of Mexico began production in April. A half mile long structure, 60 ft above the water, is the base of operations for recovering sulphur by the Frasch process. He described this unique facility, which features a plant capable of producing 5,000,000 gal of super-heated water per day and a 33,000-ft under-water pipeline for transporting molten sulphur from the offshore mine to loading facilities on Grand Isle.

P. P. Ribotto, vice president, Caland Ore Co., presented a talk on "Preliminary Engineering and Water Control for the Caland Operation at Steep Rock Lake." Over the past ten years, Caland has spent in excess of $60,000,000 on this iron ore property in Ontario. One of the more difficult problems was to develop a water control network to keep run-off water from a 25 sq mile catchment area out of the dewatered lake bottom. The company built 15 dams and associated facilities, including 4000 ft of diversion tunnels at a cost of about $4,000,000, and installed pumps with a combined capacity of over 1,000,000 gpm.

A talk entitled, "Use of Radio Communications in Small Mining Operations," was given by Arthur W. Woods, mine superintendent, Trace Elements Corp. Woods stated that after installing a radiometric assay unit for counting Beta and Gamma radiation in uranium ores to achieve close grade control, delays in the haulage operation were encountered. The company found that rapid communications would eliminate the problem and adopted the use of inexpensive "Citizen Band" transceivers designed for short range, line-of-sight operation.

Peter Nalle, superintendent of mining, Riverside Cement Co., and D. M. Cooper, senior mining engineer, U. S. Borax & Chemical Corp., discussed "Economics of Truck vs. Belt Haulage" at Riverside's underground mine at Crestmore and at U. S. Borax's open pit mine at Boron, Calif. Both companies within the past five years have changed their mining methods to one where truck haulage plays a major role. At each operation the vertical lift by trucks will ultimately be minimized by the installation of conveyor belts set at the maximum slope possible. Studies indicate that belt haulage will increase safety, reduce maintenance problems, require less personnel, permit more flexibility in the production of ore, and reduce costs.

MILLING AND METALLURGY

THE first of two sessions on Milling and Metallurgy was held on Wednesday and was presided over by R. R. McNaughton, manager, Metallurgical Division, Consolidated Mining & Smelting Co., and president-elect of the American Institute of Mining, Metallurgical and Petroleum Engineers. Robert G. Beverly, administrator-radiation controls, Union Carbide Nuclear Co., was vice chairman.

"Instrumentation for Process Control in the Milling of Copper-Molybdenum and Potash Ores" was jointly discussed by George E. Atwood, vice president and general manager, and J. P. McCarty, instrument engineer, Duval Sulphur & Potash Co. Duval has found that excellent process control has resulted from the use of instrumentation at its mineral dressing plants. Since metallurgical performance is maintained at a high level with minimum attendance, important operating economies have been realized. The company has successfully

The sessions were designed to help mining men keep abreast of new developments

applied automatic controls to crusher and crystallizer operations as well as for the control of alkalinity and pulp densities in mill circuits. Automatic control is also being used in connection with the molybdenum recovery circuit and operation of the water system and flotation machines. The company is conducting an aggressive instrumentation program aimed at advancing automation into all phases of the mineral dressing process.

R. G. Patterson, production manager of California Portland Cement Co. spoke on "Instrumentation of Plant Operations." Referring to California Portland's Mojave plant, he told how instrumentation can provide the operator with data for more accurately controlling the cement making process. With the addition of automatic controls, the process can be guided still more closely and continuously, and the operator is freed from making routine adjustments. When analog loops are added, the operator is relieved further so that more time is available for over-all process evaluations. Through these means, the company ultimately expects to achieve centralized control of plant operations.

The "Krupp-Renn Reduction Process for Treatment of Iron Ores" was the subject of a talk by Max J. Kennard, vice president, Southwestern Engineering Co. Kennard stated that this process can be used to treat certain ores that are not desirable as a direct or beneficiated charge for blast furnaces and that the reduction material can be of much lower quality than metallurgical coke. In a Renn plant, an ore and solid fuel mixture is fed through a kiln counter-current to reducing and heating gases. The iron is thereby reduced into low carbon nodules or "luppen," containing in excess of 92 percent metallic iron, which can be used as a supplemental charge in blast furnaces, or as melting stock in electric or open hearth furnaces for direct conversion into steel.

Bunting S. Crocker, vice president, Kilborn Engineering Ltd., reviewed recent "Developments in Autogenous Grinding." He said that wet and dry primary grinding and secondary pebble milling are the three main lines along which autogenous grinding has progressed. Interest in pebble milling has been particularly intense in Canada during the past year and most companies that are now erecting mills have at least considered the use of ore pebbles for grinding. Since 1956, eight companies in Ontario alone have either converted secondary mills to pebble mills or incorporated pebble mills in the original plant design. In six South African plants, 98 out of 105 grinding mills are of the pebble type, which have been found to be more economical than either ball or rod mills for the primary grind.

Mayer B. Goren, chief research chemist, Kerr-McGee Oil Industries, Inc., discussed "Plastics in Metallurgy for Resistance to Abrasion and Corrosion." He explained that certain resins resist corrosion by solutions by virtue of their polarity, whereas the non-polarity of others might cause them to swell or dissolve. He discussed thermoplastic and thermosetting properties of plastics and resins as related to their usefulness, and went on to describe some typical applications under highly corrosive and abrasive conditions that occur in uranium milling processes.

The Thursday afternoon session on Milling and Metallurgy was under the chairmanship of Jack H. How, president, Western Knapp Engineering Co.; vice chairman was Kenneth L. Tatman, mill superintendent, Idarado Mining Co.

T. G. Fulmor, assistant director of metallurgical research of the Anaconda Co., presented a report on "The El Salvador Mill of Andes Copper Mining Company," which was prepared by Andes' mill superintendent, Peter B. Hobsbawn. Fulmor, who assisted in the start up of this 24,000 tpd concentrator, covered the material that is presented as a complete article in this issue on pages 60–64.

J. Gordon Craig, mill superintendent, Hecla Mining Co. spoke on the "Construction of the New Mill and Surface Plant of the Lucky Friday Mine." Craig first of all gave a short history of Lucky Friday Lead-Silver Mines Co. and then enumerated the various factors which permitted this relatively small company to erect a well designed, easily operated, modern plant in record time and at nominal cost. Currently operating at a rate of 500 to 600 tpd, this mill was erected in nine months with local labor and supervision for a cost of less than $1000 per ton day. He discussed several interesting features of the plant, pointing out how they fit into the over-all scheme to achieve an efficient and economical operation.

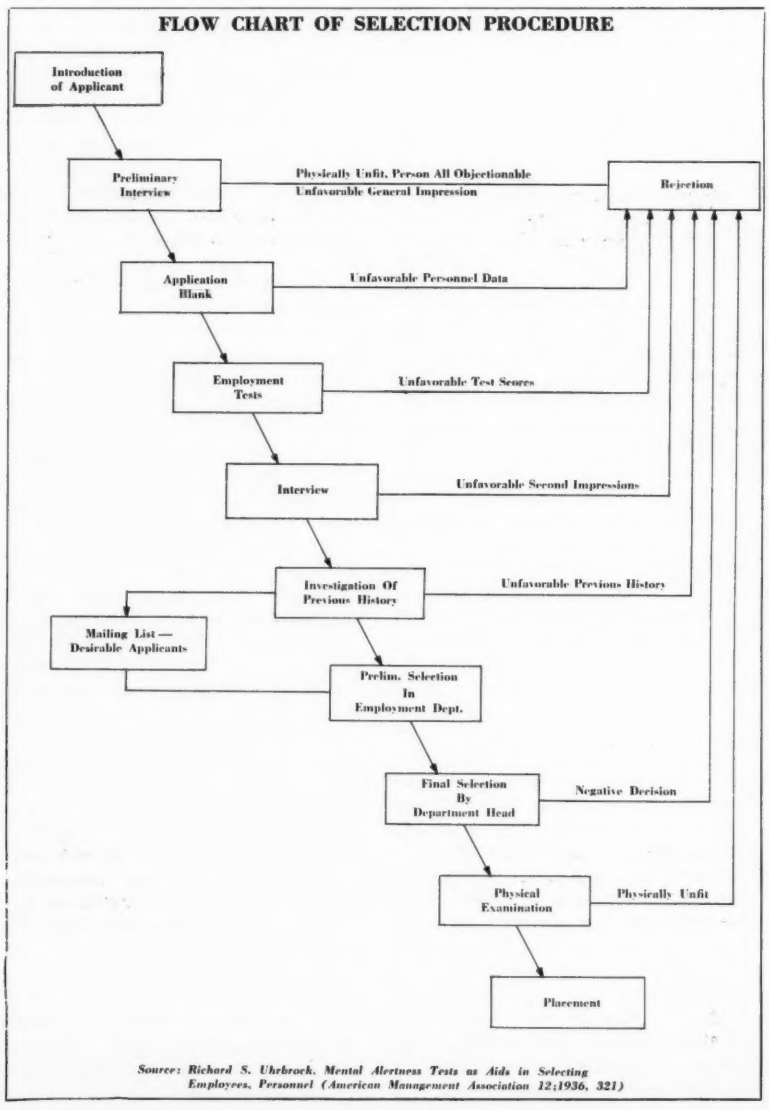
A report on "Iron Making by the Dwight-Lloyd McWane Process," was given by Robert C. McDowell, president, McDowell Co., Inc. His remarks were published in full in the October issue of Mining Congress Journal.

The final talk of the session, entitled "Developments in the Treatment of Rare Metals and Minerals," was delivered by A. J. Kauffman, Jr., chief, Albany Office of Mineral Resources, U. S. Bureau of Mines. He stated that in recent years a great deal of attention has been devoted to metallurgical research on zirconium, hafnium, columbium, tantalum, beryllium, and the rare earths. Some of the methods used to obtain concentrates of the source minerals of these metals were discussed, along with the processes employed for extracting the metals in high purity form. Reviewing some of the recent improvements in milling equipment and techniques for beneficiating rare metal ores, he described the progress that has been made in solvent extraction, ion-exchange separation, electron-beam melting, fluid-bed reactors and direct chlorination.

Personnel Evaluation and Selection

The various types of achievement and aptitude tests being used by industry can serve as a valuable tool in the proper selection of potential employes. However, that's all they are, a tool

By C. G. EVANS
Personnel Manager
The North American Coal Corp.



Source: Richard S. Uhrbrock. Mental Alertness Tests as Aids in Selecting Employees. Personnel (American Management Association 12;1936, 321)

"IN the first place, no two persons are born exactly alike, but each differs from each in natural endowments, one being suited for one occupation and another for another . . . now, is it not of the greatest moment that the work of the war should be done well? Then, apparently, it will belong to us to choose out, if we can, that special order of natural endowments which qualifies the possessors for the guardian of the state." This quotation sounds like the problems of the modern personnel departments; actually, it is a quotation from Plato* made 20 centuries ago.

Plato believed that men were born as they are. Many sociologists claim that we arrive at our present degree of proficiency and our potential performance largely by learning. Geneticists believe heredity is the determiner of personal, social, and intellectual patterns. Industrial psychologists, however, since World War II, would disagree in part with all of the statements above. They are of the opinion that biographic information pertaining to environment such as socio-economic status, past background of experience, learning, occupational experience, and the like, have shown to be somewhat more useful in predictions.**

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* *The Republic, J. L. Davis & D. J. Vaughan Translation, New York, Burt, 1866, Book II, p. 60.*

** *Bellows' and Estep's book on Employment Psychology: The Interview, pp. 22, & 23.*

Some interviewers even cling to some of the old techniques of phrenology, graphology. In fact, it is generally agreed that unless we are properly trained in this science of selection, we are prone to believe that our judgment can tell us who will work out without any analysis at all. Some people look for traits or types, according to the interviewer's training and experience. Because this is a relative matter, it is hard to get an agreement on a definition of the word "trait." Judgments on personal traits may be more wrong than right, if for no other reason than for individual differences. The use, then, of predictors or methods of ascertaining the trait we are interested in is of paramount importance. It is also obvious that the value of predictors is dependent upon their validity; therefore, valid methods of determining qualifications, traits, and abilities are one of the prime concerns of anyone dealing with selection, placement, promotion, or counselling of personnel.

Tests Are Divided Into Five Categories

The biographic, or application blank, if honestly handled, and the interviewer properly trained, is one of the most reliable predictors. However, in the case where information, which is necessary because of the nature of the job in question, is almost impossible to get from other means, predictors must be used.

Psychological tests have proven to be one of the most valid methods of this type of evaluation but they should seldom, if ever, be used alone as they do not give a completely true picture of the person being evaluated. This is primarily because of the difficulty in establishing a criterion for each job. *Psychological testing is a method of measurement which allows us to compare those who take the test with each other on some particular trait or ability.*

Trade tests or achievement tests will measure, to a degree, a man's ability to perform a certain job; however, it is of little value unless an aptitude test is used in conjunction with it. An aptitude test is designed to measure knowledge which has been acquired incidentally and not by formal or systematic training in a specific area. Aptitude testing is thus more appropriate when it is important to find out the applicant's capacity for training in a specific area. It is generally agreed that ability is never greater than capacity; therefore, it is very difficult even when you have a measure of a man's ability to know exactly what his capacity is. Even if a person has reached a certain level after training, we cannot be sure that he would not do better with better motivation.

Generally speaking, tests are divided into the following categories:

Intelligence tests which refer to the over-all mental ability of the individual.

Aptitude and prognostic tests which predict performance or learning in a new situation.

Special ability tests which attempt to measure creative ability.

Psychomotor tests which measure performance of adaptive physical activities such as coordination and speed of reaction. (North American Coal Corp. has not gotten into this area as yet).

Achievement tests which are used to determine how much a person has learned from something special, such as school.

Program Tailored to Needs of Coal Company Is Set Up

After consulting with various industrial psychologists, North American Coal selected what it thought were good men in various job classifications and poor workmen in certain classifications and they were tested by two different consulting firms, both nationally known. Approximately 100 people were tested for a sample to establish employment norms. The tests used were:

Personnel Research Classification Form, Western Reserve University. In this test group it was found that a score of 63 for mine supervisors was favorable. Between 41 and 62 was satisfactory but did need attention. Below 40 was unsatisfactory.

Army General Classification Test. In the final summation, the AGCT score is generally an I.Q. test of general intelligence. The company found that favorable supervisory would start in at about 91. The ones who were just getting by would test between 71 and 90. Below 70 was unsatisfactory. This wide variation is brought about by the inability of many of the supervisors to be able to read; therefore, allowance must be made for the level of education.

Personnel Research Institute Name Comparison Test. The ability to handle details was explored by the use of this test. The norms established on this test would indicate that a good supervisor would score at least 108 correct in a given length of time. If the score is less than 94, the applicant will not be able to take care of detail.

Probably, the two most important tests are the following:

Purdue Mechanical. This is an aptitude test since it relates to general knowledge of mechanical things, similar to the Bennett Test used by several companies. A score of 98 indicates a favorable applicant. Below 87 is unfavorable.

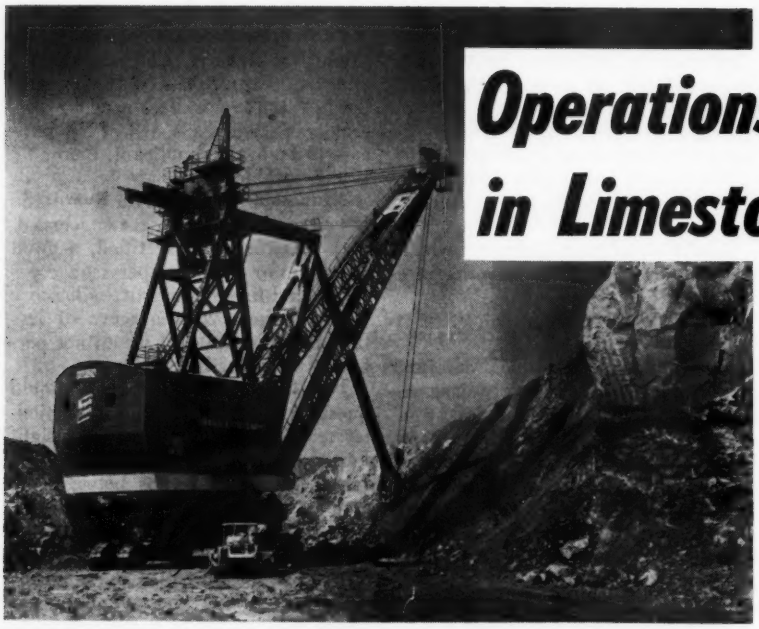
Minnesota Paper Form Board. So far as mine personnel are concerned, both classified and certified, a good mechanic or a good supervisor, especially first-line supervisor, will score 47 or higher. With a score of less than 39, the applicant would not perform satisfactorily.

How to Supervise. The writer would question the validity of this particular test. It does give you an insight into the background and training so far as the relationships between the employe and employer are concerned. The company's good supervisors scored higher than 71. Its poor ones scored below 55. Since these norms were established, the company has tested 588 people in various classifications of work. Some of the employment norms were too high and will be downgraded.

Test Results Are Only Part of Over-All Evaluation of an Individual

When the new norms are established, it should complete another tool to assist management in determining which applicant more closely compares with the company's own people and specific traits which will fit him into the job which is vacant. Management feels that hiring people at the proper intelligence level, in conformity with the position duties and promotional possibilities, is a must. The company finds that the proper biographic and interviewing application, submitted with psychological testing, should assist its people in evaluation of social and personality weaknesses, enabling management to determine ability to maintain compatible relationships with the individual's superiors, coworkers, and daily contacts. Great care should be exercised in determining personal characteristics that motivate or hinder work effectiveness.

The accompanying flow chart is probably standard in all types of industry and, if followed, present employes and new applicants are forced to realize that they have been given an equal opportunity for employment, promotion, or even in extreme cases, demotion. Thus far the company has been completely satisfied with the major results but there are still certain refinements that will require further study.



Operations Research in Limestone Mining

A detailed study by an outside consultant pointed out how improvements could be made in hauling and stripping

By DAVID G. LEWIS
Quarry Superintendent
Marquette Cement
Manufacturing Co.

Eleven-yd shovel with 160-ft boom stripping from the 130-ft highwall which covers a six-ft vein of limestone at the Superior quarry

ORGANIZING the attack on a research problem is as important an element in achieving an eventual solution as the final system itself. The particular organization plan will depend upon the scope and type of problem, the personnel and skills available, and the time allotted for reaching a solution. However, there are certain common elements to be considered in attacking any operations research problem, and a suggested plan of action that has worked successfully at Marquette Cement Manufacturing Co. is shown below:

1. Define the problem and outline desired objectives.
2. Organize the operations research team and lay proper ground work for start of study.
3. Accumulate background data from all areas concerned with the project.
4. Set up primary considerations:
   a. Define the required capabilities of the system.
   b. Logically divide the system into its major elements.
   c. Develop system criteria to be used in evaluating design concepts.
5. Analyze primary data from viewpoint of identifying operating area which contributes to cost reductions and to provide basic cost and performance data for purpose of comparing alternative type of operation. Develop points of judgment for system elements.
6. Investigate all cost reduction possibilities and alternative types of equipment. Weigh ideas for each element against point of judgment.
   a. Combine selected elements into a system.
   b. Judge the contemplated system against the system criteria.
7. Make final recommendations for new system.
8. Put new system into action.

Define the Problem

To best define what method of attack should be used, it is first necessary to clearly define the problem. Of prime importance is a definition of what operations are to be considered for research. Next, the objectives of the proposed operations research study should be clearly defined. These objectives may be of single purpose, such as cost reduction; higher output volume; elimination of toilsome jobs; improved mining techniques; or a combination of purposes.

A final area of definition is the limit to be placed on studying and designing the ultimate system. In most cases, introduction of an operations research system into an existing organization affects many areas beyond the particular mining or manufacturing area involved. By specifically defining these limits, the designing organization can be given a clear frame of reference in which to work.

This article deals with a specific operations research problem at Marquette's Superior plant located in the southern hills of Ohio. Basically the problem was how to economically and efficiently mine the limestone needed for manufacturing cement in such a way to insure sufficient reserve for long term cost reduction planning in the main plant.

The overburden at the Superior quarry is up to 130 ft thick and consists of 30 ft of shale above a six-ft seam of limestone, and the remaining hill is solid sandrock. In most cases, the slope above the operation is steeper than 45°. This, plus water in the drill holes, make a difficult drilling and shooting problem. The company must strip up to the 130-ft line in order to insure sufficient reserves. A year's production must be 430,000 tons of limestone.

When this problem was studied, the following problem definition emerged:

1. The process to be considered was the mining and "harvesting" of the limestone of the Superior plant.
2. The objective of the proposed operations research study was aimed at developing the most advantageous combination of equipment and operating practices for quarrying limestone.
3. The limit of the problem was to consider all processes in the mining of limestone from the ground preparation, through the hauling process to the crusher hopper.

With the problem thus defined, it was possible to organize a group to study and design the required system.

Organize the Team

Marquette Cement solves all the ordinary problems internally, but it was considered at the start that this was no ordinary problem. Many men,

with vast experience in heavy stripping, had reported that this job could not be done economically. The stripping of 130 ft of complex overburden for six ft of relatively cheap limestone was considered an impossibility.

New techniques in stripping appeared promising, but present personnel were unfamiliar with them. It was also know that the solution to the problem would call for a vast expenditure of capital. The problem was one that called for impartiality and objectivity which could not be assured if met by the company itself.

It was decided to call in a team of special personnel from the outside and Dunlap & Associates, Inc., was chosen to do the job. The administrative vice president of Marquette assumed the responsibility for providing information to the consulting staff, insuring cooperation of junior personnel, and expediting the work.

Research projects undertaken by an outside research team requires the attention and thoughts of management almost as much as one undertaken in the company laboratory. In order to have management well informed and in control of the project at all times, and to assure that the consulting group was staying close to the assignment, an assistant was assigned to work with the research team.

The consultants were thoroughly briefed on all relevant aspects of management's own thinking about the assignment and on relevant details of the company's organization. All of Marquette's personnel to be affected by this study were also briefed on their responsibilities.

The research organization was given at the start full responsibility for a complete study. Commensurate with its responsibility, the group was given authority, and all plant facilities were placed at its disposal. The authority to practically subpoena "witnesses" was granted, and cooperation of all concerned was insisted upon by senior management.

Accumulate Background Data

Regardless of the scope of the problem to be considered, an operations research team has to gather considerable data. In this regard, it is important to remember that stripping and quarrying operations are made up of many details, no single one of which accounts for a very large percentage of the cost of stone.

Questions on production requirements, costs, mining methods, shooting and blasting, hauling, etc., must be answered if the ultimate system is to satisfy all its diverse requirements. The answers to the questions are best obtained by direct interrogation of those most familiar with them, and this approach was therefore followed. In this way, valuable correlative data was gathered and the group became completely acquainted with all aspects of the problem.

Primary Considerations

The research team next came to grips with the actual project design using a three-point method of attack. This included a definition of the required system capabilities, the logical division of the system into its major elements, and development of a set of primary standards to be used in later evaluations.

Definition of the system capabilities: The system to be created must have the ability to recover all the limestone at Superior beneath 130 ft of overburden. (The research team made a careful study of all contour maps of the property and found this was necessary in order to have enough reserve for plant expansion.) The system must be able to load and haul 430,000 tons of limestone per year to the crusher hopper.

Major elements of stripping and quarry activities:

Clearing and terracing—Land clearing in advance of stripping. Terracing for drill.

Drilling and shooting—Drilling, loading, and shooting of overburden in preparation for stripping.

Stripping—Removal of overburden.

Stone preparation—Drilling and shooting limestone.

Stone loading — Loading limestone into haulage units.

Hauling—Hauling limestone from quarry to crusher.

Road maintenance—Maintaining all haulage roads including quarry floor. Extension of roads and spoil piles.

Supervision—Stripping and quarry supervision.

Miscellaneous — Quarry building repair: shop and tools; jeeps; fuel truck, etc.

This breakdown of operations was employed as the fundamental structure for both cost and performance analysis during the study. These operations also form the framework about which this study is organized.

Setting up the primary standards: Detailed information was collected on the methods, manpower, equipment, supplies and operating procedure associated with each aspect of the operation. Simultaneously, estimates were developed for the performance characteristics of each aspect, in terms of capacity, productivity, utilization, breakdown, delays and other relevant features. Finally, operating costs were studied for allocating costs to each operation as well as determining the distribution of cost element within operations. A complete analysis for each operation during 1956 was constructed and in this way the contribution of each operation, to total cost of quarrying limestone was estimated (See tables 1 to 5).

Each operation was then analyzed as follows:

1. Description of the present operation as to equipment, manpower and methods.
2. Analysis of the cost for 1956.
3. Evaluation of current performance.
4. Description of equipment, procedures and costs as projected for future operations.

Table 1. Summary distribution of operating costs* for 1956

A. Distribution by unit operation

Operation	Adjusted cost** per ton	Percent of total
Clearing	$ .031	3.1
Drilling and shooting (overburden)	.212	21.2
Stripping	.223	22.3
Stone preparation	.112	11.2
Loading stone	.042	4.2
Hauling stone	.224	22.4
Road maintenance	.067	6.7
Supervision	.028	2.8
Miscellaneous	.061	6.1
Total Cost Per Ton	$1.000	100%

B. Distribution by expense

Type of Expense	Adjusted cost** per ton	Percent of total
Operating labor	$ .287	28.7
Repair labor	.047	4.7
Supplies	.238	23.8
Repair parts	.261	26.1
Lubrication	.020	2.0
Fuel	.051	5.1
Outside services	.096	9.6
	$1.000	100%

* *Essentially out-of-pocket costs which vary with changes in equipment and practices. They do not include non-recurring or long-term capital expenditures, depreciation, interest, taxes, office and overhead charges, etc.*

** *Average costs adjusted for the ratios of advance of each operation.*

5. Summary of the operating cost for the current and future periods.

Analysis of Primary Data

The cost and performance analysis of the 1956 data enabled identification of operating areas which contributed importantly to the cost of stone as well as those which appeared to contribute disproportionately. It also provided basic cost and performance data for comparing alternative types of operation.

Table 1 shows how operation costs tend to concentrate. Drilling and shooting, stripping, and hauling, in about equal parts, accounted for two-thirds of the total limestone cost. In terms of the type of expense, the largest element is repairs (including parts, labor and service), which accounted for about 40 percent of the total. Operating labor and supplies represent about one-quarter each. Within each of these there is still further concentration as shown by table 2. For example, the cost of drilling and shooting is mostly supplies, the cost of hauling is mostly repairs

Side - dump trucks such as this are used to haul limestone, shale and sandrock from the quarry to the crusher station

(tires), and the cost of repairs is chiefly in wagons, bulldozer and dragline. It was clear that any important economies which were to be made would have to be found in these operations and cost elements.

The summary of performance figures for various operations and equipment (table 3) revealed lower utilization rates than might be expected, as well as substantial overtime operation for stone preparation, loading, hauling, etc. This was found to be the direct result of down time and delays arising in the haulage system, at the crusher, and at loading.

An analysis of the down time causes (table 4) revealed that factors other than equipment repair played an important part in down time. For wagon haulage, one of the important delay elements was that of bad road conditions. A separate analysis of operative performance revealed that there is a 10 to 20 percent loss in labor and equipment productivity during the normally adverse winter months as compared with summer months. Daily performance records indicated that hauling performance, together with that of associated stone preparation and stone loading, fell off 30 to 50 percent when road conditions were poor.

Each element of the operation was then studied from the viewpoint of identifying alternate procedures, equipment, materials or other opportunities which appeared to offer possible cost reduction. The most important of these were investigated and assessed and then recommendations were developed for the application or testing of potential improvements.

Some of the recommendations applied to specific unit operations, such as hauling or stripping. Others referred to general operating problems such as bad weather operation or maintenance of equipment.

Equipment Investigation

One of the main investigations was concerned with finding the most economic combination of equipment for producing the necessary limestone for a long range program.

Table 2. Summary analysis of major cost elements

Operations	Operating labor	Supplies	Repairs	Fuel	% of total stone cost
Drilling and shooting (o. b.)	$ .028	$ .156	$ .023	$ .004	21.2
Stripping	.070		.127	.026	22.3
Hauling and road maintenance	.071	.010	.191	0.19	29.1
Total for major operations					72.6%

Repairs	Cost per ton	% of total repair cost
Stone wagons	$ .170	41.7
Dragline	.103	25.2
Bulldozers	.037	9.0
Total for Major Machines		75.9%

Repairs	Cost per ton	% of total repair cost
Repair parts	$ .261	64.6
Repair labor	.047	11.6
Outside services	.096	23.8
Total	$ .404	100%

Wagon Repairs		Dragline Repairs	
Tires	70.1%	Cables	36%
Engine	11.0	Bucket	26
Brakes	7.4	Marion Parts	26
Other	11.5	Engine Parts	12
	100%		100%

Table 3. Summary performance records for operations and equipments

Clearing and terracing	
Oper. performance	381 sq ft (.01 acre) cleared/hr
Unit cost	$480/acre
Equipment: oper. cost	Bulldozer $5.08/scheduled hr
utilization	Bulldozer utilization 0.75
Drilling and shooting	
a) Drilling	
Maximum capacity	600 ft/8 hr
Operating performance	280 ft/8 hr
Utilization	47%
Drilling cost	$ .35/ft; $ .025/cu yd
b) Shooting	
Explosive ratio	2.0–2.5 cu yds/lb
Explosive cost	$12.50/cwt (Nitramite)
Unit blasting cost	$ .055/cu yd
Stripping	
a) Dragline	
Bucket factor	4.6 cu yd (bank)/cycle (6 yd bucket)
Maximum capacity	333 cu yds/hr
Operating performance	186 cu yds/hr
Utilization	56%
Unit cost	$ .083/cu yd
b) Total stripping (including dragline, Lima shovel, bulldozer)	
Unit cost	$ .101/cu yd
Stone preparation	
Maximum capacity	22 holes/hr
Performance	12 holes/hr
	81 tons/man-hour
Overtime hours	20.6%
Explosive ratio	2.9 tons/lb
Explosive cost	$ .062/ton
Total unit cost	$ .112/ton
Stone loading	
Maximum capacity	650 tph
Performance	170 tph
Utilization	31%
Overtime hours	17%
Unit cost	$ .042/ton
Hauling	
Maximum capacity (2.2 miles)	111 tons/wagon hr
Performance	50 tons/wagon hr
Utilization	45%
Overtime hours	15%
Unit cost	$ .102/ton mile

The first major equipment choice involved the consideration of underground versus surface operation. It was found that a projected modern underground mine could barely be expected to compete with the future operation of present stripping equipment using improved methods, and it would almost certainly not be competitive with an operation built around larger stripping units.

The limestone was stripped in the current method by a Marion 7200 dragline, which had the capacity for stripping about ten percent of Superior's reserve. As far as continued surface stripping was concerned, only stone hauling and stripping were found to be capable of important cost reductions through the introduction of a major new equipment system. The study focused on these two possibilities.

Initial consideration revealed that a limited number of stripping units possessed the working capacity and dumping radius capabilities required for stripping to overburden heights in excess of 110 ft and overburden ratios about 8:1 (table 6).

Projected operating costs were developed for each of these machines stripping to 110 and 130 ft. In constructing these costs, it was necessary to consider the effect on most of the unit operations involved in recovering limestone. Similarly capital requirement estimates were developed for each machine (tables 7 through 11).

An analysis of the above situation concluded that, in general, shovels are expected to produce lower limestone costs than draglines and are anticipated to decrease with increasing bucket size. The 11-yd shovel appeared to offer the highest investment yield, but is capable of stripping

Table 4. Summary analysis of operating delays and downtime

A. Dragline Stripping

Reason for delay or downtime	Percent downtime hours
Service time (fuel, lub., etc.)	15.0%
Dozer work (incl. waiting when dozer unavailable)	20.6
Shooting delay	2.9
Repairs	50.5
Miscellaneous (personal time, instructions, etc.)	11.0
	100%

B. Hauling Delays and Downtime

Reason	Percent total lost trips
Lunch period, checking time, etc.	19.8%
Shooting delay	7.7
Wagons broken down	20.5
Crusher down	17.4
Weather, minor road delays, etc.	27.3
Other	7.3
	100%

Table 5. Comparison of Costs for 1956, Current, Interim, and Future Limestone Production[1] Operating Conditions

	1956 Operation	Current[2] Operation	Projected Interim Operation (Areas 3–6)	Projected Future Operation (Area A)
Overburden ratio, cu yd/ton	2.2/1	2.2/1	2.2/1	4.7/1
Mean haul distances, miles	2.2	2.2	2.6	1.26

Unit Costs of Limestone Production, Dollars/Ton

Unit Operation	1956		Current[2]		Interim		Future	
	Cost/ Cu Yd	Cost/ Ton	Cost/ Cu Yd	Cost/ Ton	Cost/ Cu Yd	Cost/ Ton	Cost/ Cu Yd	Cost/ Ton
Clearing & Terracing	$ .014	$ .031	$ .015	$ .032	$ .014	$ .031	$ .005	$ .024
Drilling & Shooting	.096	.212	.097	.214	.075	.166	.046	.217
Stripping	.101	.223	.103	.227	.095	.210	.0485	.228
Total	2.11	.466	.215	.473	.184	.407	.0995	.469
Stone Preparation		.112		.114		.110		.104
Stone Loading		.042		.043		.043		.038
Hauling (A) In quarry								.043
(B) Quarry to crusher		.224		.229		.242		.016[3]
Road Maintenance (A) In quarry								.020
(B) Quarry to crusher		.067		.071		.070		
Supervision		.028		.035		.035		.035
Miscellaneous		.061		.060		.060		.060
Total Cost	—	$1.000	—	$1.025	—	$ .967	—	$ .785[4]

[1] *Direct out-of-pocket operating expenses only. They do not include capital expenditures, depreciation, interest, taxes, etc.*
[2] *1956 cost adjusted to current wage rates.*
[3] *Cost for operation of conveyor system ABCD with no wagon operation or road maintenance cost outside the quarry.*
[4] *Does not include any benefit from coal recovery.*

Table 6. Alternative Stripping Machine Considered for Evaluation

Machine cu yds	Manufacturer and Model	Working Capacity cu yds/hr	Dumping Radius, ft	Maximum Overburden Height, ft
	Draglines			
6	Marion 7200, diesel	219	135	—
8	Page 728, diesel	250	175	—
9	Bucyrus Erie 500 w, electric	314	203	—
12	Page 728, diesel	366	148	110
14	Bucyrus Erie 770-B, electric	442	211	130
20	Marion 7800, electric	700	263	130
	Shovels			
9	Marion 5323, electric	350	170	110
11	Marion 5323, electric	430	150	110
14	Marion 5561, electric	545	180	130
20	Marion 5561, electric	775	170	130
30	Marion 5561, electric	1160	150	110
40	Bucyrus Erie 1650-B, electric	1440	178	130

Table 7. Operating Costs, Savings, and Investments for Alternative Stripping Machines (Stripping to 110 ft)[3]

Machine Capacity	Maker & No.	Avg. Unit Cost (to Quarry Exit)	Total Cost[1] (23 years)	Avg. Yearly Cost[1]	Machine Investment[2]
	Draglines				
12 yd	Page 728	$ .923	$8,977,000	$397,000	$ 420,000
14	Bucyrus-Erie 770-B	.863	8,394,000	371,000	1,010,000
20	Marion 7800	.795	7,732,000	342,000	1,700,000
	Shovels				
9 yd	Marion 5323	$ .727	$7,071,000	$304,000	$1,070,000
11	Marion 5323	.678	6,594,000	283,000	1,070,000
14	Marion 5561	.634	6,166,000	272,000	1,800,000
20	Marion 5561	.578	5,622,000	242,000	1,800,000
30	Marion 5561	.530	5,155,000	228,000	1,800,000
40	Bucyrus-Erie 1650B	.507	4,931,000	218,000	2,480,000

[1] *Based on total tonnage of 9,726,000 in all areas.*
[2] *Includes costs of delivery and erection.*
[3] *Will result in leaving behind approximately 9.5% of the stone (2.1 years' supply) which could be recovered by stripping to 130 ft.*

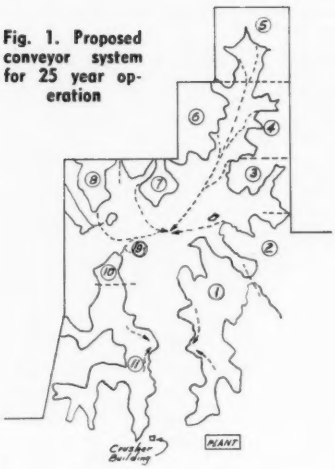


Fig. 1. Proposed conveyor system for 25 year operation

Table 8. Comparison of Stripping Machine Against 12-Yd and 14-Yd Draglines[1]

		Total Cost Saving (23 Years)	Yearly Cost Saving	Additional Investment	Net Return	Net % Return	Payoff Period (Years)	Yield on[2] Additional Investment
Comparison Against 12-Yd Dragline								
Draglines	12 yd	—	(basis of comparison)		—	—	—	—
	14	$ 584,000	$ 26,000	$ 590,000	(loss)	(loss)		
	20	1,245,000	55,000	1,280,000	(loss)	(loss)		
Shovels	9 yd	1,906,000	93,000	650,000	$1,256,000	173	7.0	13.5%
	11	2,283,000	114,000	650,000	1,733,000	267	5.7	17.5
	14	2,811,000	125,000	1,380,000	1,431,000	104	11.0	7.4
	20	3,350,000	155,000	1,380,000	1,976,000	143	8.9	10.0
	30	3,822,000	169,000	1,380,000	2,442,000	177	8.2	11.2
	40	4,046,000	179,000	2,060,000	1,986,000	96	11.5	6.9
Comparison Against 14-Yd Dragline								
Draglines	14 yd	—	(basis of comparison)		—	—	—	—
	20	$ 804,000	$ 32,000	$ 690,000	$ 114,000	16.5	21.6	0.6%
Shovels	14 yd	2,551,000	103,000	790,000	1,761,000	223	7.7	12.2
	20	3,216,000	129,000	790,000	2,426,000	307	6.1	15.9
	40	4,052,000	163,000	1,465,000	2,587,000	176	9.0	9.8

[1] *Representing the lowest machine investment enabling stripping to 110 ft and 130 ft respectively.*
[2] *Yield on additional investment is shown as a measure of the worth of any machine selection. It is equivalent to the interest rate which would produce a return of interest and principal (additional investment) at an annual rate equal to that shown for yearly savings.*

to only 110 ft resulting in about 10 percent loss in stone. The 20-yd shovel offers the highest investment yield consistent with maximum stone recovery, but the final choice of machine depends upon some sort of balance between economic return, future expansion possibilities, the importance of maximizing stone recovery, preferences with respect to the ease of planning and conducting operation, and the availability of capital (table 13).

Hauling Investigation

Three alternative hauling systems considered for evaluation included haulage entirely by DW-20 Athey rock wagons from the quarry to the crusher; part wagon and part tramway haulage; and part wagon and part conveyor haulage. In all cases, wagons were considered as the only feasible means for following progression from the quarry. Tramways and conveyors were considered only as substituting for part of the distance from crusher to quarry (figure 1).

Estimates were developed for the haulage distances covered by wagons, trams and conveyors, in servicing each of the reserve areas on a year by year basis. Unit and ton-mile hauling costs were projected for each section and component of the various systems and total unit costs developed for each reserve area. Similarly, capital investment and capital replacement expenses were estimated for wagons, trams and conveyors (table 14).

The research team then concluded that the tramway system proposed had both higher operating and capital costs than a comparable conveyor. Comparing the conveyor-wagon system against an all wagon system, the conveyor could be expected to result in considerable savings.

Recommendations

After careful analysis of all information and facts, the operations research team reported that the stripping and harvesting of limestone at the Superior plant was economically possible and made the following recommendations:

Stripping and Hauling

Stripping: Replacement of the Model 7200 dragline, which lacks the capacity and reach to uncover more than 10 percent of the stone at Superior, with a Model 5323, 11-cu yd stripping shovel. This machine appears to be the most suited to future operations in terms of capacity and economy. A complete stripping plan was recommended.

Hauling: A belt conveyor system, used in conjunction with stone wagons, should be constructed between the main crusher

Blast holes 130 ft deep are drilled in the highwall and shot with ammonium nitrate explosives. This view shows the highwall which has been blasted ahead of the stripping shovel and the bull-dozed drill road

Table 9. Operating Costs, Savings, and Investments for Alternative Stripping Machines (Stripping to 130 ft)

Machine Capacity	Maker and No.	Avg. Unit Cost (to Quarry Exit)	Total Cost[1] (25 Years)	Avg. Yearly[1] Cost	Machine Investment[2]
	Draglines				
14 yd	Bucyrus Erie 770B	$ .902	$9,669,000	$388,000	$1,010,000
20	Marion 7800	.827	8,865,000	356,000	1,700,000
	Shovels				
14	Marion 5561	$ .664	$7,118,000	$285,000	$1,800,000
20	Marion 5561	.602	6,453,000	259,000	1,800,000
40	Bucyrus Erie 1650B	.524	5,617,000	225,000	2,475,000

[1] *Based on total tonnage of 10,720,000 in all areas.*
[2] *Includes cost of delivery and erection.*

building and stripping pit. The primary crusher should be of a portable nature and first located at point "D," then at "F," and finally at "G." This system appeared to be the most economical method of hauling stone. Indirect advantage is that it can reduce effect of weather or hauling delays, which produce down-time and overtime in other operations, and lessen the seriousness of the over-all maintenance problem, much of which is due to wear and tear on wagons.

Table 10. Operating Cost Projections for Stripping to 130 ft in area A* (Comparison of Present and Proposed Systems)

	Present Operation (50 ft)	Projected Best with Current Equipment (90 ft)	Projected Operation with 20-yd Shovel and 3450 ft Conveyor (130 ft)
Overburden ratio	2.2:1	.1:1	5.2:1
Unit Operation			
Clearing & terracing	.036	.030	.024
Drilling & shooting	.225	.310	.163
Stripping	.232	.397	.136
Stone preparation	.121	.100	.100
Stone loading	.050	.045	.045
Stone hauling (Quarry to crusher)	.229	.200	.016
Stone hauling (In quarry)			.054
Road maintenance	.095	.082	
Supervision	.028	.030	.030
Miscellaneous	.074	.050	.050
Total Limestone Cost	$1.090	$1.244	$ .618

** Includes direct operating expenses only. Does not include fixed and overhead charges, main road construction costs, and capital replacement costs.*

Recommendations for future operations (Based upon Model 5323, 11-cu yd shovel and conveyor haulage).

Clearing and terracing: Relatively little savings possible in this operation. Avoid excess amount and distance of earth movement. Do minimum work required for maneuvering drill. Clear only necessary drill path. Leave remaining trees and vegetation to be removed by shovel.

Drilling and shooting: Important cost reduction possibilities exist for shooting. An experimental blasting program should be initiated (A detailed plan was included in report). Substitute ammonium nitrate explosives where possible. Maintain close control over explosive ratio and hole spacings.

Stripping: Employ the Model 5323 shovel in a modified form of contour-following stripping plan. (Detailed plan included in recommendations.) The plan proposed will enable near minimum haul distance, proper separation of equipment and operations, fairly uniform machine scheduling, maximum stone recovery and suitable uncovered stone reserve. Exert every effort for complete utilization of shovel. Give careful attention to and control over lubrication, dozer work, shift changing, etc. Future repair and maintenance needs should be anticipated whenever machine is down for major repair. Keep bulldozer in constant attendance at shovel.

Table 11. Reserve Capacities of Various Machines

Machine Capacity		Maximum Scheduled Hours Per Week Required for 430,000 Tons/Year		Extra Hours Available	Expansion Potential (extra hours available)
		110 ft	130 ft		
Draglines	12	164		4	2.4%
	14		166	2	1.2
	20		105	63	60.0
Shovels	9	165		3	1.8%
	11	135		33	24.4
	14		127	41	32.3
	20		90	78	86.7
	30	50		118	236.0
	40		48	120	250.0

Stone preparation: Initiate experimental program aimed at reducing drilling and shooting cost. Slowly increase hole spacing and/or reduce explosive charges until increasing costs of secondary blasing and crushing make further changes undesirable. Change shooting times so as to reduce delays in hauling caused by interference of blasting. Increase productivity in stone preparation operation by eliminating third man on drilling crew and by reducing overtime.

Stone loading: Increase productivity of stone loading equipment by reduction of overtime. This will require a reduction of delays and down-time in hauling and crushing. Make strong efforts to avoid stone losses in quarry. This will require stripping as closely as possible to edge of outcropping, keeping spoil piles from falling back and overlapping edge of stone, and more careful attention to clean-up.

Haul.ng: In rease utilization of rock wagons by reducing down-time and delays. This will require elimination of blasting during periods of wagon operations; alterations to crusher to eliminate stoppages; use of after-hour maintenance for wagons and crusher; better preventive maintenance in wagons; keeping down-time records on wagons, and similar measures.

Schedule overtime hours only during good weather—never when road conditions are poor. Suspend operations on muddy and bad weather days. Maintain roads in first class condition.

Table 12. Recommended Stripping Machines for Maximum Economic Return

Policy Decisions	Recommended Stripping Machine
Maximum stone recovery (up to 130 ft overburden) Most convenient stripping	20 yd Marion 5561 shovel
Maximum stone recovery, (to 130 ft) Up to 100% allowance for future expansion	20 yd Marion 5561 shovel
Loss of 10% more stone in Areas 1–11 (to 110 ft) Up to 50% allowance for future expansion	11 yd Marion 5323 shovel
Loss of 10% more stone Up to 200% allowance for future expansion	30 yd Marion 5561 shovel
Limited availability of capital	11 yd Marion 5323 shovel

Give constant attention to problems of tire wear (50 percent cost of hauling). Keep careful records of tire life and reasons for failure; check inflation frequently; watch for spots on haul roads where tires spin; train drivers in tire care and protection.

Haulage should be by stone wagon from the quarry to the primary crusher at the conveyor terminal.

General operating problems

Maintenance of equipment: This is probably the most important single problem of Superior. Repair forces should be increased

Table 13. Alternative Hauling Systems Considered for Evaluation

All wagons			Caterpillar DW-20 tractors with 33 ton Athey wagons
Wagons plus tram			300 tons/hr, jig-back tramway, 2900 ft long serving Area A
Wagons plus conveyors			300 tons/hr hooded conveyor with primary crusher a conveyor terminal
Conveyor Section	Designation		
Initial Section	ABCD	3450 ft	serving Areas A
Extended System	ABCEF	6840 ft	serving northern reserve areas
Initial Section plus spur	ABCG	3640 ft	serving area 11

Table 14. Summary Comparison of Alternative Haulage Systems (from quarry exit to crusher)

	Conveyor System ABCD	Conveyor Addition CEF	Conveyor Addition CG	All Conveyors
Gross savings (operating plus wagon replacement expense)	$774,000	$682,800	$152,800	$1,609,600
Cost of conveyor investment	354,000	324,000	100,000	778,000
Net savings	$420,000	$358,800	$ 52,800	$ 831,600
Net return on investment	118.6%	110.7%	52.8%	106.9%
Period for return of conveyor investment	4.9 years	6.4 years	2.6 years	
Equivalent yield* on investment for:				
6 year period (Area A)	6.3%			
15 year period from time of investment	12.5%	12.4%		
Period covering exhaustion of reserves	12.8%	12.4%	18.5%	

** Equivalent yield has been computed as an index of worth for the investment alternatives shown, Example: $354,000 invested at 6.3% for 6 years would return $72,600 per year including compound interest plus return of capital. This is equivalent to investing in conveyor system ABCD in area A for six years operation.*

by one or two men, preferably working in staggered shifts, so that vital machines can be returned to service more rapidly.

Improve maintenance facilities in keeping with the fact that almost half of the cost of limestone derives from repair, service and inadequate utilization of equipment. Consider relocating maintenance shop nearer quarry.

Improve communication facilities between repair shop, office and quarry; increase preventive maintenance; and take greater advantage of maintenance repair and replacement opportunities when equipment is down for repairs. Use planned down-time for maintenance when possible.

Improve maintenance and repair records system in order to keep close control over costs and to help diagnose reasons for recurrent failures.

Bad weather operations: Two primary problems develop because of winter weather effects—poor road conditions and difficulty in starting equipment. On poor days, labor productivity, as measured by wagon loads per available crusher hour, averages only 50 to 70 percent of that on good days. In addition to productivity losses during bad weather, most vehicles suffer substantial wear and tear.

It is recommended that sufficient reserves of stone be maintained to enable shutting down in bad weather. It is estimated that a one to two month supply will make this possible.

Operations should be suspended when road conditions are poor and not resumed for one to five days, depending upon weather and reserve supplies. Overtime should never be scheduled during poor weather or when road conditions are bad.

Record keeping and control: Cost and performance information must be available in sufficient detail to provide an effective measure of performance for each operation.

Improve records and allocation of costs between operations, machines and other cost elements. Summarize cost of limestone by operation, machine, and type of expenditure monthly for purpose of local control. Compute productivity and performance measures from the records.

Plot performance and cost figures monthly on control charts. Use these charts for diagnosing and correcting trouble spots and for maintaining continuous pressure for cost reduction. For anticipated future cost see table 5.

Recommendations Put Into Action

Upon the completion of the recommendations and upon explaining and turning over detailed descriptions of procedures, findings, conclusions and recommendations to Marquette, the job of the research team was finished.

The complete transcript of the study was then reviewed by responsible Marquette personnel. The recommendation regarding the Marion 5323 11-yd shovel was accepted, and the necessary arrangements for its delivery were to be made at once. However, the boom length was modified to 160 ft. It was also agreed that the other recommendations be put into effect as soon as equipment and adequate supervisory personnel were available. However, since a large capital expenditure on crushing equipment had already been made prior to the report, it was decided to try the present haulage and crushing method with minor modifications as recommended by the report. (Should this prove to be unprofitable, necessary changes will be made at a later date.)

A search of Marquette's personnel was made to secure adequate supervisors for this job. It was decided that an outside stripping engineer was needed to take charge of placing the operations research study into action, and the writer was hired for the job. A father-son team was chosen for quarry and stripping foremen.

The Model 5323 shovel was ready on January 1, 1959, and the recommendations of the operations research study were put into action.

It must be emphasized at this point that any operations research study, and the recommendations which it contains, can only help point the way to potential cost improvement. The real pay-off is an affirmative answer to the question: "Are Costs Being Reduced?"

Objective Has to Be Spelled Out

The actual achievement of these gains must depend upon the willingness of all management and supervisory personnel to view each opportunity as a challenge—to find the means for making the proposed changes work. This requires testing each proposal, modifying it when difficulties are encountered and improving upon it when possible. It requires continuing measurement of cost and performance for each part of the operations in such a way that trouble spots can be detected as soon as they occur and that changes can be evaluated as they are made.

Just as the future of cement is bright, the future of any individual cement company is equally bright—but neither is guaranteed. A bright future can only be earned competitively. Cost reduction is a job that is never done. There must be an ever active, well defined program designed to exploit every available means to greater productivity at lower cost.

Cost reduction and design of a new stripping method cannot be a hit and miss proposition. Everyone in the organization must know what has to be done. The objective has to be spelled out. The study outlined here brought into sharp focus the specific objectives and detailed the means by which these objectives were to be realized. Now management has the responsibility of getting the job done. Experience has taught that only with an organized team applying its combined skills and efforts can a company expect maximum accomplishment of the recommendations when putting an operations research study into action.

THE EL SALAVADOR MILL

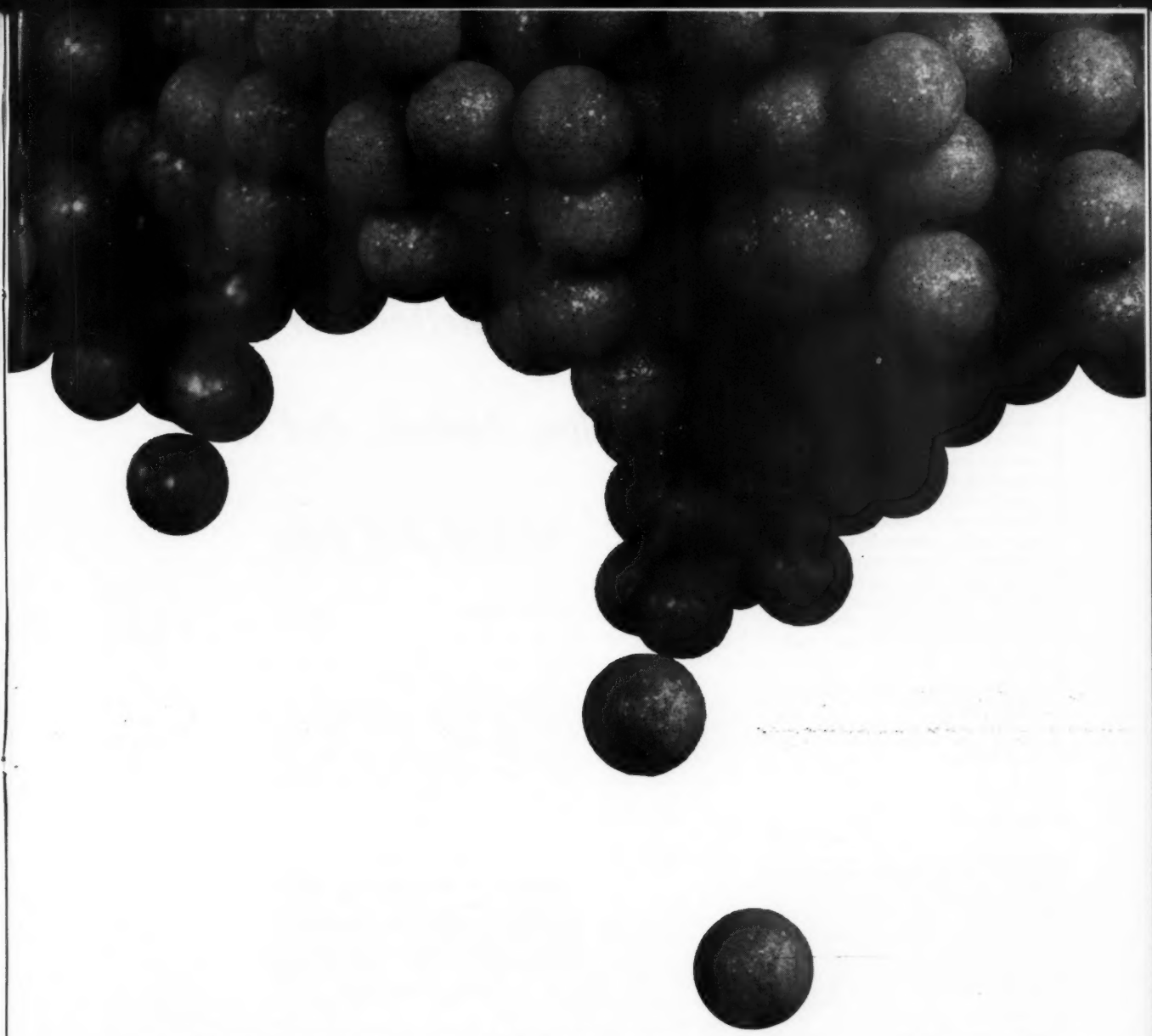
(Continued from page 64)

tical application of the metallurgical procedures, indicated by the test work, can largely be attributed to good control, in particular, of the flotation circuit. While many are the contributory factors, three will be singled out here for special mention.

The first factor resides in the design of the flotation circuit, featuring double cleaning of bulk concentrates and separate treatment of the first cleaner tailings in the scavenger circuit. Besides making the visual control of the circuit easier for the operator, the causes of poor operation can be more easily determined and hence more speedily corrected. New operators find the circuit relatively simple to understand.

Another contributory factor is the definition of the duties of the flotation machine operators, to include the entire sequence of interdependent operations, from the flotation of the bulk concentrate, its thickening and regrinding, to the final cleaning stages and the scavenging operation. Under these conditions, the operator is in a position to anticipate the effect, on one part of the circuit, of any adjustment he himself may make further upstream.

Lastly, a significant contribution to good circuit control, especially as regards the grade of flotation products, was made by the provision of means to make X-ray spectrographic determinations of copper, iron and molybdenum on dried and prepared pulp samples. An X-ray laboratory, a sample preparation mill, two small wet chemical laboratories, and a flotation testing laboratory are housed in the concentrator office building. By means of the X-ray spectrometer, determinations of copper iron and molybdenum can be made on the same prepared sample in two minutes. With this unit operating on a 24-hour basis, operators are provided with vital information, while it is still of practical use to them.



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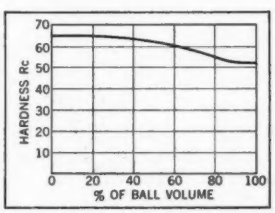

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Today the United States coal industry faces the pending impact of the adoption of international standards for evaluating coal and coke. In these days of buying and selling commodities according to strict specifications there can be no doubt of the vital necessity for recognized standard methods for sampling and analysis both in domestic and in international trade. Coal and coke are no exceptions. Development of these international standards has been in progress for more than ten years and will proceed with or without United States participation. Here is the story of the why and how of this activity and of United States participation both past and future

International Standardization of Methods For Sampling, Analysis, And Testing of Coal And Coke

By

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MOST of the nations of the world have their own standards, but when applied internationally, confusion resulted because often each country's standards and the values obtained using them differ significantly from those of others. With ever increasing world trade, the United Nations recognized the problem by fostering in 1946 the formation of the International Organization for Standardization (ISO) "to promote the development of standards in the world with a view to facilitating international exchange of goods and services and to developing mutual cooperation in the sphere of intellectual, scientific, technological, and economical activity."

Technical Committee 27 on Solid Mineral Fuels of ISO (ISO/TC 27) is responsible for the development of international standards for coal and coke. Committee D-5 of the American Society for Testing Materials, through the American Standards Association, is participating to the limit of its ability, as is the Committee on Coal Preparation of the American Mining Congress, in this important effort for the benefit of the United States coal industry. This report is presented in an attempt to better acquaint the industry with this activity and to point out the urgent need for full cooperation of the industry with the committee's efforts.

How ISO Works

Membership in ISO is held by recognized Standards organizations in each nation. For the United States, membership is held by the American Standards Association. This organization has the primary function of coordinating, on the national level, standards as prepared by other technical organizations. As it is not a standards formulating body, it depends on Committee D-5 of ASTM to develop national standards for coal and coke. In line with this, Committee D-5 was designated by the American Standards Association as the official U. S. group to conduct active participation in ISO/TC 27 and to advise ASA on actions to be taken as a member of ISO. To implement this responsibility, Committee D-5 set up

a special Subcommittee (XXVII, American Group ISO/TC 27) with a chairman and the chairmen of each of the active subcommittees of D-5 and also the members of the Advisory Subcommittee.

Since its organization, ISO/TC 27 has worked to develop methods for sampling, analyzing, and testing coal and coke that will be acceptable to the majority of the member nations. Thirty-five countries are represented on this committee, including all the important coal-producing nations in the world. Two types of membership are recognized—"participating" and "observer." Participating members take part in all deliberations of the committee and are expected to vote on all questions; observer members may take part in all deliberations but have no voting rights. Membership of the committee comprise the following countries:

Participating members—Australia, Austria, Belgium, Canada, Czechoslovakia, Denmark, France, Germany, India, Italy, Japan, Netherlands, New Zealand, Poland, Rumania, Spain, Turkey, United Kingdom, United States of America, Union of Soviet Socialist Republics, and Yugoslavia.

Observer members—Brazil, Burma, Bulgaria, Chile, Greece, Hungary, Ireland, Mexico, Norway, Pakistan, Portugal, Union of South Africa, Sweden, and Switzerland.

The secretariat of ISO Technical Committee 27 is vested in the United Kingdom, with the British Standards Institution doing an outstanding job in directing and coordinating the massive amount of detailed work involved.

Briefly, the activities of ISO/TC 27 are conducted as follows: Existing national standards, recommendations, and suggestions are submitted to the secretariat by member countries. The secretariat may issue them as documents to members, or it may assign them to working groups or subcommittees for consideration. Actually, most of the proposals originate in the working groups or subcommittees which are made up of those countries who agree to serve on them. To be most effective the opinions, objectives, and recommendations should be presented at the working group or subcommittee level.

Working group reports are submitted to the main committee and the secretariat issues them as documents for the consideration of all members of the committee. The status of these documents also is discussed at plenary sessions of the main committee. Drafts for particular items may be revised several times and following approval, be designated as a Draft ISO Recommendation. The draft recommendation is then submitted for postal approval by a majority of the committee with modifications if necessary by the secretariat to meet valid suggestions for amendment, and are finally submitted to all member bodies. If the draft is not approved by 60 percent of the member bodies voting, the secretariat may submit revised drafts until the necessary 60 percent approval is obtained. The approved Draft Recommendation is then submitted to the ISO Council which decides whether it should be accepted as an ISO Recommendation, and in addition, whether the recommendation should be resubmitted to ISO member bodies for adoption as an ISO Standard. Approval by 100 percent of the member bodies is required for adoption as a Standard.

What Progress is Being Made?

Methods for sampling, proximate and ultimate analysis, ash-softening temperature, coking and caking properties, physical properties of coke, and coal preparation terminology and performance are now under consideration. The present status of these items is detailed in the appendix to this report. Despite its length, it can no more than suggest the large amount of time that has been devoted to careful consideration of the twenty subjects listed.

A natural question is—what progress is being made and of what benefit is U. S. participation in the international standardization work? From a positive approach, approximately 500 lengthy documents on various subjects have received consideration and opinions or votes submitted through the ASA. Several members and their organizations also have contributed time and facilities for obtaining the necessary test data to support the U. S. position on certain items. In addition, delegates have been sent to four of the five plenary meetings of ISO/TC 27 and to seven of the twenty-four meetings of the various subcommittees and working groups, all of which have been held in Europe.

Although Committee D-5 has participated to the limit of its ability, it encounters problems difficult to resolve. The development of replies representative of the thinking of U.S.A. technologists is a slow process. Furthermore, the securing of needed analytical data often is too slow to be effective. The very nature of ASTM work and its activities in a free-enterprise society such as ours dictate this because it is necessary that such data be developed on a voluntary basis by committee members whose first duty is to their own organizations. In striking contrast, the participation of other countries in ISO work often is underwritten largely by the individual governments and competent technical personnel are assigned virtually full time to the projects under study.

The fact that all of the meetings of ISO/TC 27 (both working groups and plenary sessions) have been held in Europe has been a severe handicap to U.S.A. participation. Drafts of methods are prepared at the subcommittee or working group level and the United States, unrepresented, has little or no influence on the context of these methods. Sending a delegate to a meeting in Europe costs at least $750. Since neither ASA or ASTM can supply funds for travel, expenses have been met in part by the generosity of a few coal companies and associations, research organizations, three exporters' associations (of which two no longer exist), and some small funds held in the treasury of D-5. With such assistance the United States has been represented in a comparatively small way. Continued participation is now doubtful or, at best, will be even more severely limited. It might be said that Committee D-5 of ASTM has carried the burden of active interest and participation in the ISO work for the past 10 years. If participation in the development of international standards for sampling, analysis, and testing of coal is important to the coal industry in the U. S., further financial support must be obtained.

How Do We Benefit?

What are the benefits to our coal industry accruing from U. S. A. participation? The primary purpose of the standardization work is to provide international standards by which coals entering international trade may be evaluated. The United States is the largest coal-exporting nation in the world. It is logical, therefore, that for the protection of our coal industry, particularly the segment producing coal for export, the United States should have a voice in the formulation of coal and coke standards that will be used on a worldwide basis. It should also be realized that international standards will be written whether or not there is any participation by the United States.

Other benefits deriving from U.S.A.

participation can be mentioned briefly. Committee D-5 has obtained information and data that are of value in either formulating new or re-evaluating our present national standards. Information on the conditions and requirements in other countries has given a better understanding of coal problems and technology on a world-wide basis. Delegates to the meetings have come to know many of the world's ablest coal technologists who are contributing their experience and knowledge to the international effort. Finally, it is hoped that the U.S.A., in some small way, has also contributed in the technical area to the intangible but real value of the movement towards international cooperation and good will.

In conclusion, as mentioned earlier, many of the member countries consider international standardization urgent, and are therefore investing heavily in this effort. The United States seriously needs to make a greater effort towards the goal of international standards. To achieve this, more funds, personnel, and laboratory investigative work are essential.

APPENDIX
Status of work of ISO Technical Committee 27

Item No.	Item	Studied since	Stage of development
1	Determination of moisture	1950	(i) Revised draft proposals on three methods for total moisture have been approved by Working Group 2. (ii) Revised Draft ISO Recommendations for moisture in analysis sample by direct gravimetric method and direct volumetric method are being prepared for submission to ISO Council. (iii) Revised draft proposal for moisture-holding capacity (general method) is being prepared. Simplified and rapid methods are being investigated.
2	Determination of ash	1950	ISO Recommendation approved for publication.
3	Determination of calorific value	1950	(i) Draft proposal for calorimetric bomb method circulated for postal ballot; comments are under review. (ii) Adiabatic bomb method to be studied.
4	Determination of carbon and hydrogen	1950	(i) Revised Draft ISO Recommendation for Liebig method is being prepared for submission to ISO Council. (ii) Revised draft proposal for high temperature method is being prepared for postal ballot.
5	Determination of total sulfur	1950	(i) ISO Recommendation for Strambi method approved for publication. (ii) Revised Draft ISO Recommendations for High temperature method and Eschka method are being prepared for submission to ISO Council.
6	Determination of nitrogen	1950	Revised Draft ISO Recommendation for Kjeldahl method and semi-micro Kjeldahl method are being prepared for submission to ISO Council.
7	Determination of oxygen	1951	In abeyance.
8	Determination of volatile matter	1950	Draft proposal circulated for postal ballot; comments are under review.
9	Reporting of results	1951	In abeyance.
10	Determination of ash fusibility	1951	Draft proposal circulated for postal ballot; comments are under review.
11	Swelling and caking tests	1951	(i) Draft proposal for crucible swelling number circulated for postal ballot; comments are under review. (ii) Draft ISO Recommendation for Audibert-Arnu test circulated by General Secretariat; comments under review. (iii) Draft proposal for Gray-King test circulated for postal ballot; comments are under review. (iv) Limit of agglutinating value: in abeyance. (v) Revised Draft ISO Recommendation for Roga method is being prepared for submission to ISO Council. Other methods: questionnaire in preparation.
12	Determination of phosphorus, chlorine and arsenic	1951	(i) Draft proposals for phosphorus by the gravimetric method, volumetric method, and colorimetric method to be circulated shortly for postal ballot. (ii) Direct method for phosphorus: questionnaire circulated. (iii) Revised Draft ISO Recommendations for chlorine by the Strambi method and the High temperature method, are being prepared for submission to ISO Council. (iv) Draft proposal on chlorine by the Eschka method to be circulated shortly for postal ballot. (v) Draft proposal for arsenic by the absorptiometric method to be circulated shortly for postal ballot.
13	Determination of forms of sulfur	1951	ISO Recommendation approved for publication.
14	Methods of sampling	1951	Draft proposals being studied by Working Group 7 on preparation of the analysis sample and sampling from conveyors and falling streams; draft proposals in preparation by Working Group 7 on sampling from wagons, sampling from ships, and preparation of the moisture sample.
15	Mineral matter	1953	Draft proposal to be circulated for postal ballot.
16	Coal Preparation	1954	(i) Draft proposal for coal preparation terminology under revision by Subcommittee 1. (ii) Draft proposals in preparation by Subcommittee 1 on methods of expressing performance of coal preparation plant, flowsheets, and symbols.
17	Brown coals and lignites	1955	(i) Revised draft proposal on yields of tar, water, gas, and coke by low temperature distillation being prepared by Subcommittee 2. (ii) Draft proposals on moisture and ash under discussion by Subcommittee 2.
18	Physical testing of coke	1955	Draft proposals on Micum and Shatter tests circulated for postal ballots; comments under review. Size analysis, bulk density, and other physical tests are being studied by Working Group 8.
19	Physical testing of coal	1958	Methods to be studied.
20	Chemical analysis of coke	1958	Draft proposals in preparation by Working Group 8 on total moisture, moisture in the analysis sample, and ash.

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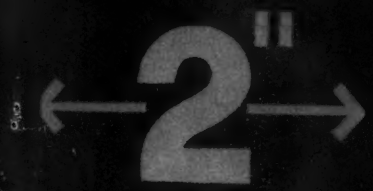

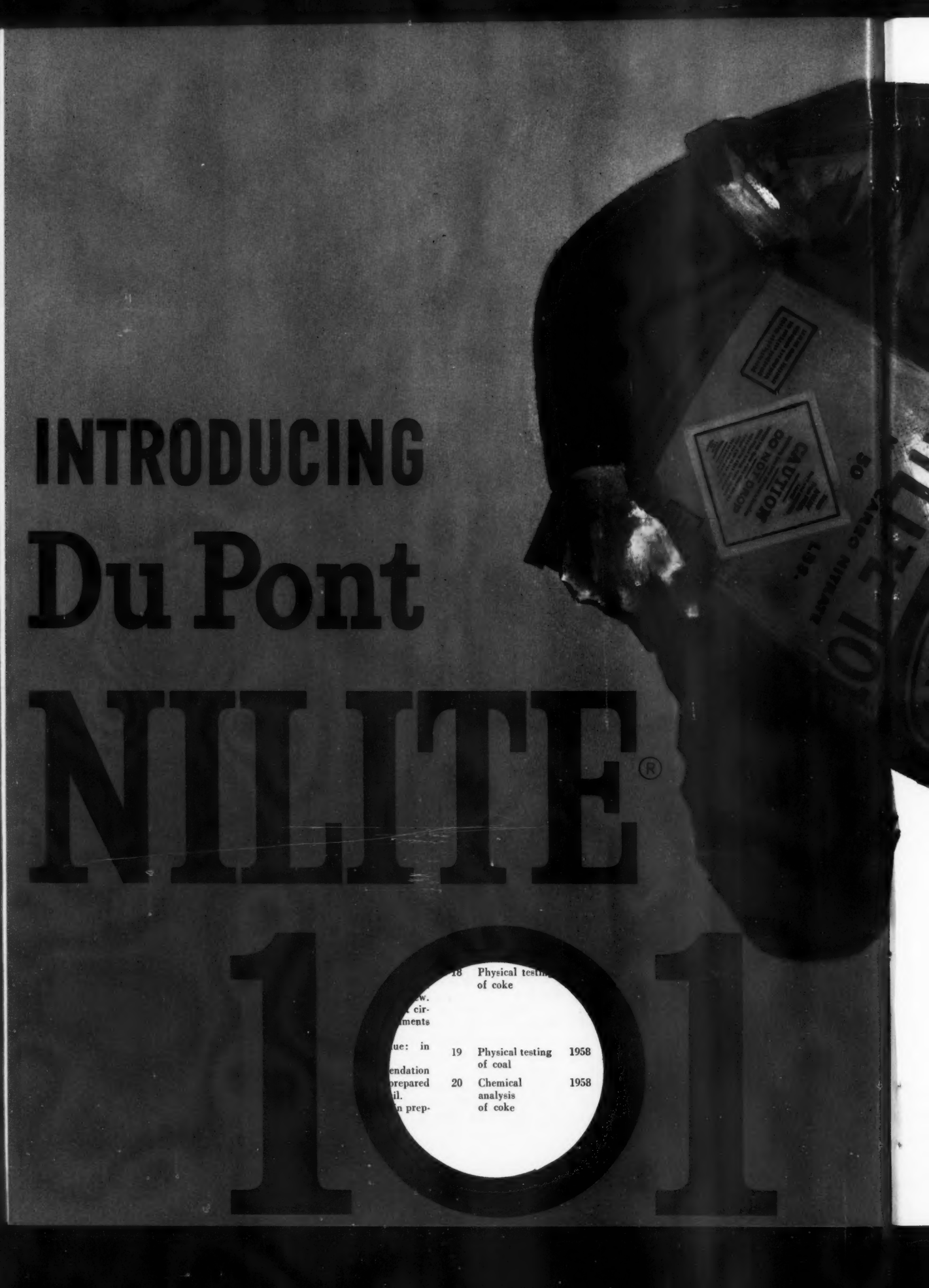
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You don't mix "Nilite" 101 on the job. You don't mix it at all. Just rip open the bag and pour it into any hole —small, medium, large—from 2″ diameter up. No clogging, no bridging in the hole.

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It has a rock-breaking wallop you've learned not to look for in "economy" explosives. In fact, you'll get performance equal to that of 60% extra dynamite.

What else?

We've counted 12 ways you'll save time, save money and move more rock per day.

They're on the next page . . .

Flows freely even in holes as small as . . .

1. LOW COST The low price of "Nilite" 101, plus the low labor costs (no mixing on the job, no caked and hard-to-pour bags), add up to real blasting economy.

2. NO MIXING No oil to buy or store. No costly or potentially hazardous mixing on the job. Just tear open a bag of "Nilite" 101, and pour it into the hole.

3. NO LOST STRENGTH Because there's no on-the-job mixing, you don't risk losing strength through ineffective blending which can decrease an explosive's potential strength by 30% or more.

4. NO CAKING The particles of "Nilite" 101 are designed to resist setting and caking, even in storage. It stays free-flowing longer than other bulk explosives not so designed.

5. EASY LOADING Pours freely into holes as small as 2″ in diameter. Fills the entire cross-section of the hole.

6. NON DUSTING Even when loading on windy days, there is no dust problem with "Nilite" 101.

You owe it to yourself to investigate AND PROFIT BY the advantages now possible only with the new

DU PONT "NILITE" 101

7. NO HEADACHES "Nilite" 101 will not cause headaches among your blasting crew.

8. EASY PRIMING "Nilite" 101 performs reliably when primed with small dynamite or high detonation pressure primers.

9. EXCELLENT BREAKAGE "Nilite" 101 consistently outperforms field mixed blasting agents in producing desired fragmentation.

10. BETTER PROPAGATION "Nilite" 101 is considerably more sensitive to propagation than prill/oil mixtures.

11. GREATER SAFETY "Nilite" 101 is a true nitro-carbo-nitrate (NCN) blasting agent as defined by the Interstate Commerce Commission, and as such is vastly safer to use than any type of dynamite.

12. REPRODUCIBLE RESULTS From shot to shot, you can get dependable results with "Nilite" 101—manufactured under the quality control standards that have established Du Pont explosives as performance leaders in all types of blasting.

UNTIL *YOU* tear open a bag of "Nilite" 101, you'll never know whether you are paying more than you should for each blast.

For a demonstration or a detailed description of Du Pont "Nilite" 101, call your Du Pont Explosives representative or distributor, or send the coupon.

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DU PONT EXPLOSIVES DEPARTMENT
6440 NEMOURS BUILDING, WILMINGTON 98, DELAWARE

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NAME .....

COMPANY ..... TITLE .....

ADDRESS .....

CITY ..... ZONE ..... STATE .....

1961 AMC Coal Show

F. Stillman Elfred

Next May 13–18 the eyes of the coal mining world will again be focused on Cleveland, Ohio, where the 1961 Coal Show of the American Mining Congress will be in full swing. Sharing the spotlight at that time will be a provocative technical program, designed to bring the industry up to date on the latest advances in mining and preparation techniques, and the largest exhibition of mining equipment ever assembled.

The technical program will be drafted at a mid-November meeting of the National Program Committee. Under the chairmanship of F. Stillman Elfred, Chairman of the Board, Peabody Coal Company, the committee is made up of a cross-section of the coal industry. It includes operators from all the major coal fields, representing both deep and strip mines, and mining equipment manufacturers. Committee members and their company affiliations are listed below.

The 1961 Coal Show will offer an unparalleled opportunity to inspect and compare the most recent advances in the tools of the industry. Equipment manufacturers are doing everything they can to make this the greatest Coal Show ever held. These efforts mean that those who attend will get more out of the meeting than ever before.

It is not too early to make plans to attend!

Members of Program Committee—1961 Coal Show

F. Stillman Elfred (*Chairman*), Peabody Coal Co.

Marling J. Ankeny, U. S. Bureau of Mines
E. M. Arentzen, Lee-Norse Co.
C. P. Arnold, Peabody Coal Co.
Charles B. Baton, Joanne Coal Co.
P. W. Bigley, Centrifugal & Mechanical Industries, Inc.
L. C. Black, Bucyrus-Erie Co.
George F. Bowers, Standard Oil Co. (Indiana)
A. P. Boxley, Eastern Gas & Fuel Associates
Harry W. Bradbury, Glen Alden Coal Co.
N. T. Camicia, Island Creek Coal Co.
S. Austin Caperton, Jr., Slab Fork Coal Co.
L. H. Chalfant, Bethlehem Mines Corp.
W. C. Clayton, KW-Dart Truck Co.
Jesse F. Core, U. S. Steel Corp.
W. J. Crawford, Enos Coal Mining Co.
M. F. Cunningham, Goodman Manufacturing Co.
D. E. Davidson, Link-Belt Co.
J. B. Dempsey, Pattin Manufacturing Co.
E. T. Eggers, American Steel & Wire Div., U. S. Steel Corp.
Lonnie D. Ellison, Island Creek Coal Co.
J. A. Erskine, Eastern Gas & Fuel Associates
George A. Evans, Evans-Elkhorn Coal Co., Inc.
W. A. Gallagher, Stonega Coke & Coal Co.
A. G. Gossard, Snow Hill Coal Corp.
W. D. Hamilton, Oglebay Norton Co.
Gilmore Hiett, Gorman-Rupp Co.
J. J. Huey, United Electric Coal Cos.
Albert M. Keenan, Thompson Creek Coal & Coke Corp.
J. J. Kelleher, Hercules Powder Co.
J. W. MacDonald, Old Ben Coal Corp.
B. H. McCrackin, Southern Mines, Republic Steel Corp.
W. D. Moreman, Sanford-Day Iron Works, Inc.
Charles Nailler, Consolidation Coal Co.
Frank Nugent, Freeman Coal Mining Corp.
C. B. Peck, Jr., Anaconda Wire & Cable Co.
John Peperakis, Sunnyside Coal Mines, Kaiser Steel Corp.
George M. Perry, Euclid Div., General Motors Corp.
Edwin R. Phelps, Peabody Coal Co.
Henry E. Pruner, U. S. Rubber Co.
B. E. Rector, Westinghouse Electric Corp.
J. J. Reilly, Jones & Laughlin Steel Corp.
J. M. Richards, Blue Diamond Coal Co.
A. E. Seep, Mine & Smelter Supply Co.
Chester G. Sensenich, Irwin-Sensenich Corp.
G. A. Shoemaker, Consolidation Coal Co.
G. R. Spindler, School of Mines, West Virginia University
John W. Straton, Lorado, West Virginia
R. H. Swallow, Ayrshire Collieries Corp.
Woods G. Talman, U. S. Steel Corp.
H. M. Tibbs, Truax-Traer Coal Co.
Carl K. Tieche, Clinchfield Coal Co.
R. T. Todhunter, Jr., Barnes & Tucker Co.
R. S. Walker, Bradford Coal Co.
R. F. Wesner, Boone County Coal Co.
Everett White, Mine Safety Appliances Co.
J. E. M. Wilson, The Jeffrey Manufacturing Co.
James H. Wilson, Salem Tool Co.
Roland P. Wilson, Bell & Zoller Coal Co.
J. W. Woomer, Pittsburgh, Pennsylvania
J. A. Younkins, Duquesne Light Co.

As Viewed by HENRY I. DWORSHAK of the American Mining Congress

BEFORE this issue of Mining Congress Journal reaches its readers, the American people will have elected a new President to succeed Dwight D. Eisenhower, the Nation's Chief Executive since January 20, 1953. The new President will be formally inaugurated at the Capitol next January 20.

At the same time, the electorate will have filled 437 House and 34 Senate seats (terms of the other 66 Senators have either two or four more years to run). The 87th Congress will convene January 3; it is expected to transact little but routine business until the new President submits his legislative program later in the month.

While the authorized membership of the House currently is 437, the total will revert to 435 following reapportionment of seats based on the 1960 Census. The two additional seats were given to the new States of Alaska and Hawaii to provide them with representation until the upcoming reapportionment is completed. The U. S. Constitution guarantees each State at least one Representative regardless of its population.

TARIFF COMMISSION HEARS IRON ORE PRODUCERS

Growing imports of iron ore have resulted from the needs of domestic steel companies and are not due to any concessions made under the Trade Agreements Act, iron ore and steel industry spokesmen testified at a Tariff Commission hearing last month.

Imports of iron ore have been entered free of duty since 1913, and the only concessions made under the Trade Agreements Act with respect to such imports have been their "binding" on the free list in agreements dating back to 1944. The hearing was part of a Tariff Commission investigation to determine whether, as a result of these bindings, iron ore is being imported into the United States in such increased quantities, either actual or relative, as to cause or threaten serious injury to the domestic iron ore industry.

W. H. Johnstone, vice president, Bethlehem Steel Co., testified that his company, a major producer and consumer of domestic iron ore, is vitally concerned with the continued welfare of that industry. Whatever decline in domestic production has taken place, he said, is the result of factors such as depletion of high-grade domestic deposits, requirements by the American steel industry for higher quality ore, and a new trend towards decentralization of that industry away from traditional domestic production centers,

Herbert C. Jackson, executive vice president, Pickands Mather & Co., said his company, which accounts for about 15 percent of the annual shipments of iron ore from the Lake Superior District, "is opposed in principle to the establishment of any tariff or quota on iron ore imported into the United States because the free importation of iron ore is needed to supplement our domestic supply." He agreed with Johnstone that factors other than free tariff treatment accounted for the increase in imports.

Jackson added: "The importation of foreign ores should not be discouraged by any tariff or quota imposition, which would merely handicap the competitive ability of the iron and steel industry, seriously weaken our defense potential and not improve the domestic iron ore industry. . . . our domestic iron ore industry can grow and expand, providing reasonably fair tax treatment is accorded, excessive rail freight rates are corrected, and the operating efficiencies are continued."

Others at the hearing whose testimony was substantially similar were R. W. Whitney of M. A. Hanna Co.; William J. Harnisch of Youngstown Sheet & Tube Co., and Carl B. Jacobs, Inland Steel Co.

A representative of the United Steelworkers of America, AFL–CIO, told the Commission that American companies, in seeking new foreign sources of iron ore, "were not motivated by lower wages, less favorable working conditions, or the absence of unions abroad. . . . The chief justification for iron ore sources abroad is the simple fact that even with the new mines in the United States, and the expanded pelletizing facilities, we still cannot produce enough iron ore to supply the steel industry at capacity or near-capacity operations."

The Tariff Commission must submit its findings and recommendations to the President by January 5, 1961.

HIGH COURT REVIEW ASKED IN ESCAPE-CLAUSE CASE

The Justice Department has asked the U. S. Supreme Court to review a decision of the Court of Customs and Patent Appeals which affects the President's powers under the escape clause of the Trade Agreements Act of 1951.

This case arose when an importer of bicycles protested the increased

Washington Highlights

IRON ORE: Producers testify at Government hearing

ESCAPE CLAUSE: Supreme Court asked to review case

FREIGHT RATES: ICC permits coal, iron ore hikes

WATER POLLUTION: National conference is scheduled

STOCKPILE: Purchase commitments reach new low

MINING MACHINERY: Manufacturers tell of export problems

rate of duty assessed under a Presidential Proclamation issued in 1955 pursuant to an escape-clause proceeding. The proclaimed rate was lower than the rate recommended by the Tariff Commission; the importer contended that the President's power was limited to approving or rejecting the Commission's recommendation and that he was not authorized to modify or to adopt only partially the action recommended. The Customs Court found in the importer's favor, and this decision was affirmed by the appellate court.

In its petition to the Supreme Court, the Justice Department said the case calls for review because the decision "improperly interferes with Presidential powers in the important area of tariffs and foreign trade." It also "throws doubt" on the validity of the President's 1958 Proclamation imposing import quotas on lead and zinc, the Department said. After citing pertinent language from the Tariff Act of 1930, the petition stated: "The contrary position of the court below should not be permitted to stand."

The Supreme Court may announce later this year whether it will review the case.

RAILROADS RAISE RATES ON COAL AND IRON ORE

Late last month the Interstate Commerce Commission permitted the railroads to make a general increase in freight rates, including 7 cents per ton on bituminous coal and 11 cents per gross ton on iron ore.

In its decision, the Commission noted that bituminous coal "is the most important commodity handled by the railroads and they so state. The coal movement has favorable transportation conditions but it is very susceptible to the competitive influences of other types of fuel. The railroads in this proceeding are proposing lower increases on this traffic than on other commodities and have indicated that where subsequent developments indicate that increased coal rates adversely affect the use of coal or shipment of coal by rail, they will institute reductions as required to meet the competitive situation."

SURGEON GENERAL CALLS WATER POLLUTION MEETING

At the request of the President and the Secretary of Health, Education and Welfare, Surgeon General Leroy E. Burney of the U. S. Public Health Service has called a National Conference on Water Pollution to be held in Washington, D. C., December 12–14. Purpose of the conference, Burney said, is to assess "the problem of water pollution, to determine its effects upon our national welfare, and to set realistic goals for its control."

More than 1,000 representatives of government, industry, labor and civic groups are expected to participate. General sessions are scheduled for December 12 and 14; December 13 will be devoted to separate panel sessions dealing with (1) the impact of water pollution on public health and economic development; (2) water resources management; (3) the legal, financial and public responsibilities of government and industry, and (4) research and training needs.

A banquet December 12 will feature a round-table discussion of national water problems by Senators Kerr (Dem., Okla.) and Case (Rep., S. D.) and Reps. Blatnik (Dem., Minn.) and Cramer (Rep., Fla.).

STOCKPILE REPORT SHOWS COMMITMENTS AT LOW EBB

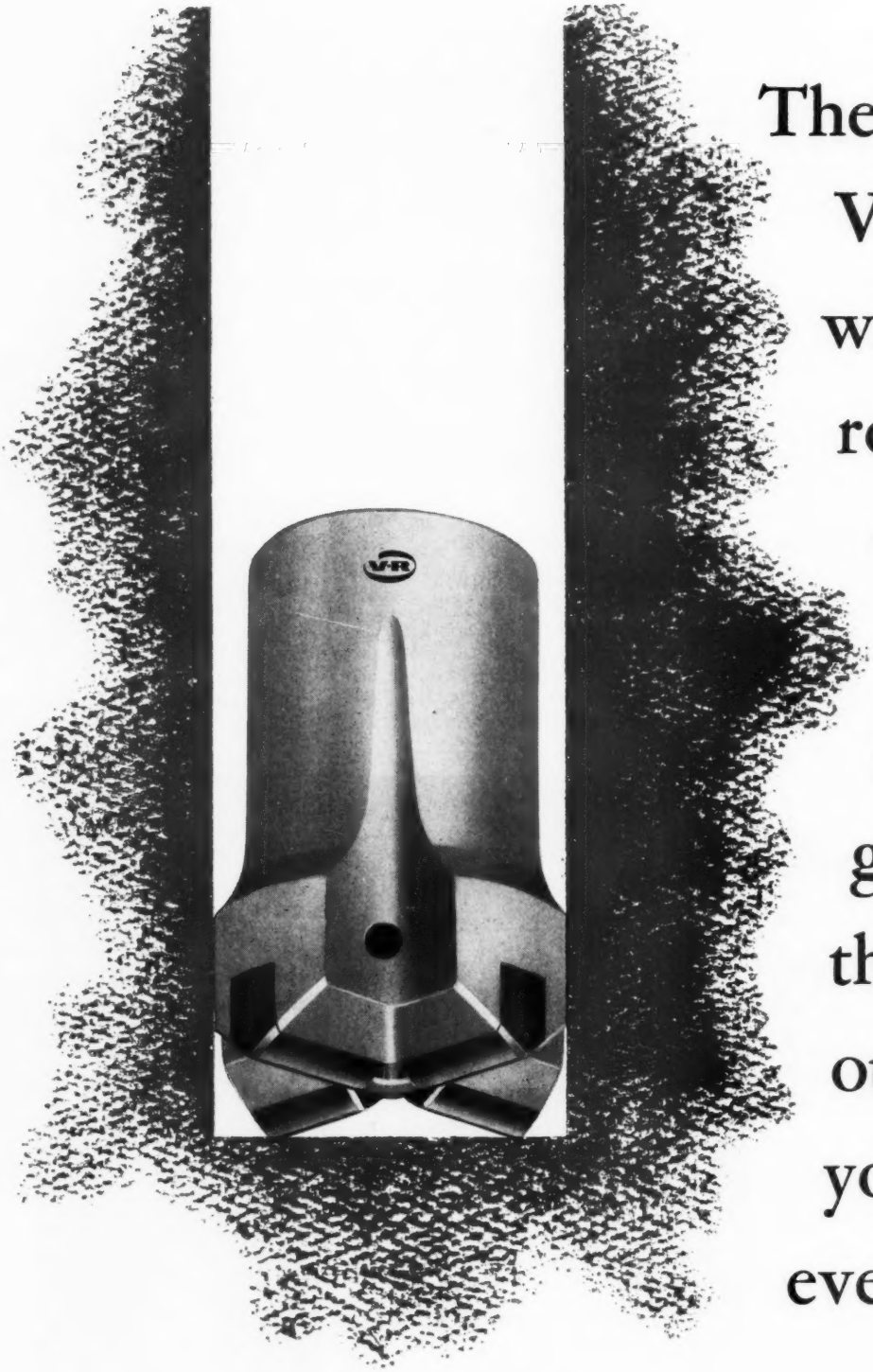
New commitments for open-market purchases for the national stockpile reached a new low of $459,000 during the first half of this year, the Office of Civil and Defense Mobilization noted in its semiannual Stockpile Report to Congress. "This relatively small amount is the consequence of stepping up efforts to obtain by barter or by payment in kind the materials needed against strategic stockpile objectives," OCDM reported.

Total specification-grade inventories in the strategic stockpile June 30, 1960, were valued at $6 billion, compared with a December 31, 1959, market valuation of $6.1 billion and an acquisition cost of $5.8 billion.

The report noted that materials valued at approximately $7.2 million were delivered to the strategic stockpile as a result of previous commitments. Materials on order June 30 were valued at $5.9 million.

"Strategic stockpile inventories for the 76 materials on the stockpile list as of June 30 approximately equalled or exceeded maximum objectives for 53 materials and basic (minimum) objectives for 64 materials," OCDM said. "Additional quantities in other Government inventories, if added to the strategic stockpile, would change these totals to 61 maximum objectives and 71 basic objectives. Quantities on order would complete 2 additional

(Continued on page 127)



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for Bottoming Drive Rods ..... for Shoulder Drive Rods ..... for Throw-away and Multi-grind Push-ons

personals

E. R. Phelps has been appointed chief engineer of Peabody Coal Co.

Phelps, who is chairman of the American Mining Congress Committee on Strip Mining, recently returned from a trip to India where he was part of a three-man consulting team which went there to advise the country in developing a program for expanding its coal production.

Peter Colefax, president of American Potash & Chemical Corp., has been named chairman of the board of directors. He will continue as president, in which capacity he has served since 1947.

Holly W. Sphar has been elected to the newly created position of vice president-planning and commercial development, Consolidation Coal Co. He will be responsible for long range planning for the company both in coal and other investment opportunities, including the commercialization of projects originated by the Research and Development Division.

Walter J. Nock has been appointed vice president of the Mexican Division, American Smelting & Refining Co. The Mexican Division includes all of Asarco's properties, sales activities and other interests in Mexico including ten mining operations, a copper smelter at San Luis Potosi, a lead smelter at Chihuahua, a lead refinery at Monterrey, and a zinc smelter, coal mines and coke plant at Rosita. Nock was formerly general manager of the company's Mexican Mining Department.

Maurice F. Dufour, vice president, Freeport Sulphur Co., has been appointed director of the company's research and development activities. He is also executive vice president and a director of Freeport Nickel Co., a subsidiary whose nickel-cobalt mining and concentrating facilities in Cuba were seized last August by the Cuban government.

H. J. Hager was recently named to the newly created position of vice president—operations, Alabama By-Products Corp. He was formerly vice president—mining operations. At the same time, former general superintendent of mines **G. C. Dyar** became vice president—coal mining operations, and **W. E. Self** was appointed to Dyar's former position.

Francis J. Haller, a consulting engineer in the iron ore industry, has been named a director and consultant of the Jubilee Iron Corp. Jubilee has extensive iron ore properties in the "Labrador Trough". Haller has been associated with iron ore mining since 1930. He is a former vice president of the North Range Mining Co. and now is their consultant.

Carl A. Marshall, formerly vice president-sales for Warner Collieries Co., has joined the National Coal Association as a field engineer for the eastern district of the Air Pollution Control Division. He succeeds **George W. Biven,** who resigned. Marshall has been associated with the coal industry since 1929.

Harold E. Robbins, formerly general superintendent of Andes Copper Mining Co., has been promoted to assistant manager. Robbins will be in direct charge of the company's El Salvador copper mine and concentrator project. He began his employment as a mine foreman with Andes Copper in 1938, and in 1953 was named general superintendent.

AMC Coal Research Committee

A Committee on Coal Research has been organized within the framework of the Coal Division of the American Mining Congress.

Dr. H. B. Charmbury, Head, Department of Mineral Preparation, College of Mineral Industries, The Pennsylvania State University, has been named Chairman of the committee, which will devote its first attention to the gathering of information on coal research projects currently being carried on in the various mining colleges and universities.

Dr. Charmbury has been associated with Penn State since 1937, first in the Department of Petroleum and Natural Gas, then in the Department of Fuel Technology and, since 1950, in the Department of Mineral Preparation. He has served as technical consultant on various mineral problems for a long list of companies. His research experience covers a wide range of subjects and he has authored numerous technical reports and articles.

Three appointments in the executive and technical staff of Western Operations, United States Smelting Refining & Mining Co., have been announced. **Benton Boyd** was named assistant to the vice president, **Harold H. Wells** became general superintendent of the U. S. and Lark mines, and **John W. Conrow** was appointed chief geologist. Boyd had been manager of the U. S. and Lark mines since 1957, and Wells had been superintendent at the Lark since 1952. Conrow joined the exploration department in 1955 as a geologist.


B. Boyd

Bill E. Christian has been appointed director of industrial and public relations at the White Pine operations of White Pine Copper Co. Christian was formerly employed by Kennecott Copper Corp. as director of industrial relations at Chino Mines Division.

Roland G. Smith has been appointed chief tax counsel and head of the tax department, Pickands Mather & Co. At the same time, **William H. Hamilton** was named assistant tax counsel. Smith, an attorney, joined PM in 1929 and has been assistant tax counsel since 1953. Hamilton, also an attorney, has been with Pickands Mather for 14 years.


R. G. Smith


W. H. Hamilton

William M. Fiedler has been appointed to the newly-created position of assistant general manager, planning and development, for the Ore Mines and Quarry Division of Jones & Laughlin Steel Corp. He will be responsible for long-range planning of the Division. Other changes in the division include the naming of **Edward L. Beutner** as chief geologist to succeed Fiedler. Beautner formerly was assistant chief geologist. **Robert M. Crump,** formerly staff geologist, becomes chief mining engineer. **Clarence H. Sleeman,** chief mining and development engineer, has resigned to accept a position with another company.

Ray W. Jenkins, consultant in mining and construction, has joined the Ralph M. Parsons Co., Los Angeles. Jenkins was most recently with the Mining and Milling Division of Phillips Petroleum Co. and the Mining Division of Anderson Development Corp.

A. J. Francovich has become general mine superintendent of White Pine Copper Co.

Norman I. Heaton recently was named to the new post of superintendent, Desert Mound mine, Columbia Iron Mining Co. He has been succeeded as superintendent of the Iron Mountain mine by **H. Dale Milne. Garff K. McMullen** took over as general foreman, Milne's previous position.

John E. Bemis, formerly assistant superintendent on the Cuyuna Range for M. A. Hanna Co., has been promoted to superintendent. **Leonard J. Morgan** has replaced **John Gernert** as assistant superintendent of South Agnew-Morton mines in the Minnesota District. Gernert has been transferred to the company's Mississippi Group.

George W. Cosgrove, previously manager of the Alpha Portland Cement Co. plant at Lime Kiln, Md., has been promoted to manager of process engineering for the company. **Dale W. Heineck** succeeds Cosgrove as manager at Lime Kiln.

B. L. Bessinger has joined International Minerals & Chemical Corp. as a mine project engineer at its Carlsbad, N. M., operations. He had previously been employed by Hughes Tool Co., and, before joining Hughes, had held mine engineering positions with Duval Sulphur & Potash Co.

Milton F. Williams, previously a research supervisor in the Oliver Iron Mining Division, U. S. Steel Corp., was recently appointed manager of the company's Provo, Utah, raw materials research laboratory, Columbia-Geneva Steel Division.

C. E. Schwab, president, Bunker Hill Co., has been elected a director of the company following the retirement of **W. W. Crocker.** Crocker had been on the Bunker Hill board since 1939 and his father before him for about 45 years.

OBITUARIES

Carel Robinson, 79, internationally known consulting mining engineer and chairman of the board of Robinson & Robinson, died in Charleston, W. Va., September 20.

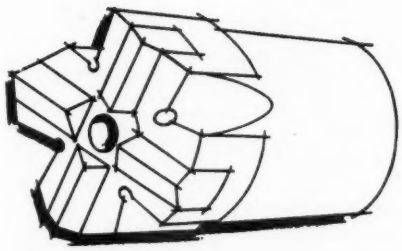
Mr. Robinson's consulting work included studies of the Belgian coal industry and French, German and Turkish mines under auspices of the Marshall Plan and on coal properties in the United States and Canada.

John F. Magee, 67, chairman of the board, Alpha Portland Cement Co., died in Easton, Pa., August 4.

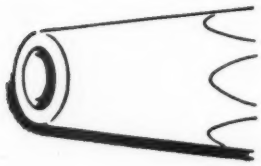
Donald M. Davidson, 58, president of E. J. Longyear Co. and a geologist with a world-wide reputation, died in Minneapolis, Minn., September 15.

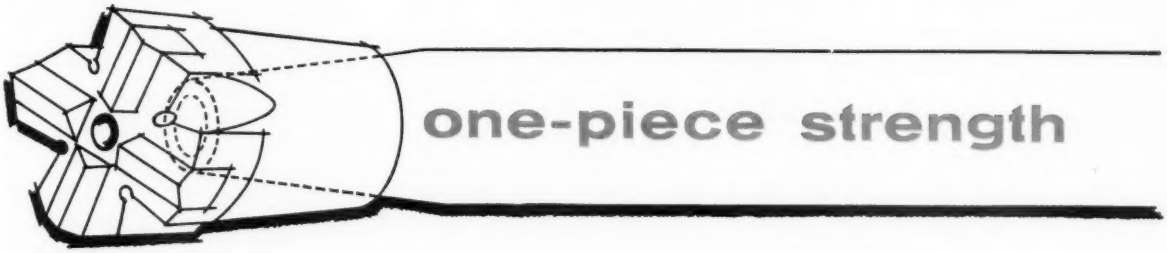
Dr. Davidson joined Selection Trust, Ltd., in 1928 and had risen to chief geologist and senior engineer by 1939 when he became chief geologist for Longyear. He was later head of the Mining Division and became vice president in 1949. He was named president of Longyear in 1958.

Dr. Davidson was a member of the National Minerals Advisory Council from 1950 to 1952 and president of the Society of Economic Geologists from 1953 to 1954. He served as a consultant to the Atomic Energy Commission and U. S. Bureau of Mines and made many contributions to the fields of mining and geology.



This removable bit gives





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And those Timken bits save you even more because only a pocketful are needed for a day's work. Compare that to lugging an armful of intra-sets to the mine face.

Still another reason: with Timken bits you can change bit gauge sizes fast on the same steel. No changing the whole steel.

What's more, *only* the bit itself need go in for resharpening. You don't have to haul the whole steel. And Timken bits give longer gauge wear because there are four cutting edges. Most intra-sets have only two.

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FASTER CHIP CLEARANCE because five front holes shoot air or water directly against the rock face. And deeper, wider wing clearance lets chips wash back faster.

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The Westfalia Coal Planer, the only *truly* continuous miner, with new Westfalia self-advancing, hydraulic roof supports and the ability to operate in thick or thin seams, will cut costs while increasing production. The Westfalia system is fully adaptable to room and pillar mines.

You reduce costs because the durable Westfalia Coal Planer lowers maintenance and repair expenses, requires no other roof supports or bolting and is operated by a minimum crew. You eliminate cutting, drilling, explosives and all other loading equipment.

Production goes up because you extract all the coal across a working face which may extend up to 800 feet or more. Production is continuous since the Westfalia planer, conveyor and self-advancing roof supports press continually against the face. Burnt or sticking top coal is removed by the planer automatically.

The Westfalia System, first brought to this country through the cooperation of the U.S. Bureau of Mines and a coal producing company, has proved itself in several hundred installations in all important coal mining areas of the world. Results soon will be available from the latest installation in West Virginia.

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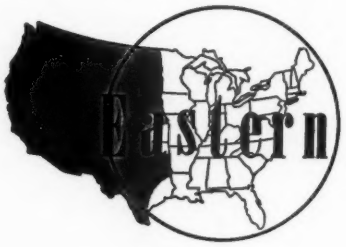
NEWS and views



Construction Set on Coal Research Center

The board of directors of Bituminous Coal Research, Inc., has authorized BCR to proceed as soon as possible with construction of a coal industry central laboratory in the Pittsburgh suburb of Monroeville, Pa. The building will cost $650,000 to $700,000 exclusive of the site and equipment already owned. When completed and equipped, total value will be approximately $1,000,000.

Research executives from the coal, power, railroad, steel, equipment and chemical industries will advise BCR's management during final planning to assure that the laboratory will have the basic ability to provide research results of the type needed as rapidly as possible.

Contributors of funds for the laboratory include coal companies, 48 electric utility companies which consume more than half of the coal burned by that industry, and 40 equipment manufacturers and coal industry suppliers, including chemical companies, engineering firms and others.

Ore Sampling, Analysis Standards to be Studied by A.S.T.M.

American Society for Testing Materials' newly organized A.S.T.M. Committee E-16 on sampling and analysis of metal bearing ores and related materials has announced an extensive work program. Subcommittees on sampling, analytical procedures, physical testing, and definitions have been organized by representatives of companies directly participating in or supervising the evaluation of metal bearing ores and related materials.

The sampling and chemical analysis of iron ore, manganese ore, chrome ore, and fluorspar are being reviewed in eight task groups. Two other task groups are studying sieve testing and the size degradation of ores and agglomerates. A questionnaire will be directed to industry covering the tumbler test procedures. Compilation of these data will serve as background for the development of a test method for size degradation evaluation.

New Coking Technique Holds Promise

A new technique employing a rotary hearth type furnace, similar to that used in metallurgical operations, has been developed for the continuous production of metallurgical grade coke. Requiring only about a quarter as much auxiliary equipment as other coking processes, the new process operates continuously instead of in batches—as in the beehive and by-product processes. Where desirable, the exhaust gases can be collected for processing into coal tar by-products. The ability to use low grade coals to produce low moisture content, high quality coke further enhances the economical factors relating to the rotary hearth furnace coke production method.

The development is the result of a cooperative effort between Salem-Brosius, Inc. and the New York Mining and Manufacturing Co. of New York City and Dorchester, Va. These firms, which have entered into a joint agreement to put the process into operation, will develop a pilot-type furnace immediately, and later will build units about 70-ft in diameter. The production goal for the 70 ft diameter coking furnaces is about 5000 tons of high grade metallurgical coke per month, from approximately 8000 tons of coal. Because of the reduction in equipment requirements, such as coal crushing and cleaning, and coal preparation facilities, and the reduction in labor requirements, the cost per ton of produced coke is expected to be lower than that of other processes now in use.

John Kemmerer, president, and Josh Taggert, vice president, of New York Mining & Manufacturing Co. indicated that the pilot production unit will be erected on the company's property at Dorchester, Va., and will be in operation late in 1960.

A giant wheel excavator recently went into operation at Peabody Coal Company's River King mine in Illinois. Used to strip overburden, the new machine weighs over 3,000,000 lb and stands 150 ft high. The digging wheel itself is 24 ft in diameter and is equipped with nine buckets which dig as the wheel rotates. A 54-in. wide conveyor belt carries the material away at speeds in excess of 1000 fpm. Used in conjunction with other coal-stripping machinery, the wheel excavator, it is felt, will provide an economical means of mining coal which lies more than 100 ft below the surface of the earth.


New Wheel Excavator Goes to Work in Illinois

Bethlehem Sets Up Research Department

C. H. H. Weikel, assistant to president for the past three years, was recently named a vice president to head Bethlehem Steel Company's newly created Research Department. The action, effective immediately, consolidates under one department the Research Division of the Steel Operating Department; the Commercial Research and Development Division, which has been part of the Sales Department; and the Raw Materials Research Division, formerly in the Mining Department. Growth of Bethlehem's research activities in many directions has made it advisable to establish a single department for maximum efficiency.

TVA to Mine Phosphate

TVA will soon begin mining phosphate from an area west of Franklin, Tenn., in Williamson County. Operations are expected to start within the next few months. Mining will be extended to other areas in the County later.

Phosphate will be mined from lands owned by TVA and from land on which TVA owns mineral rights. It will be shipped, along with phosphate from other areas, to the TVA chemical plant at Wilson Dam, Ala.

Radioisotope Used to "Tag" Coal in Research Project

Researchers of the U. S. Bureau of Mines are using the radioisotope Gallium-68 to "tag" tiny particles of coal to aid in their studies for finding new and improved uses for coal. Because of its extremely short life, Gallium-68 is proving ideal for use in experimental equipment for creating synthesis gas from coal. A small amount of the isotope, suspended in a liquid, is dried onto a coal sample before its journey through the gasifier. Progress is readily traced from the gamma rays which are emitted and which carry through heavy pipe walls to detecting devices.

Cerro Expands Peru Operation

Cerro de Pasco Corp. directors have approved expenditures of $6,825,000 for plant additions in Peru. The new projects involve modifications of two production facilities. The electrolytic zinc plant, located at La Oroya, is to be increased in capacity from approximately 32,000 to 52,000 short tons of special high grade zinc per year. Completion is scheduled for June 1962.

In addition, the concentrator at Cerro de Pasco, site of the company's principal operating mine, is to be expanded to accommodate increased volume of copper ore and lead-zinc ore to be mined by open pit methods. This project is expected to be completed by the end of 1961.

ALSO . . .

The U. S. Bureau of Mines manganese research program in fiscal year 1961 will concentrate on metallurgical and mining research, with less emphasis on resource studies. The Bureau will continue to direct its efforts towards economic utilization of the large low grade and refractory manganese resources.

Public Service Electric & Gas Co. recently dedicated a new power plant at Richfield, N. J. The station, with two turbines each capable of producing 290,000 kw of power, consumes 4000 tons of pulverized coal per day.

The Chicago and Northwestern Railway will use infrared heat rays to thaw frozen iron ore near its big dock at Escanaba, Mich. A metal building 276 ft long will be constructed this fall to house infrared heating elements. Iron ore in railroad cars moving into the building will absorb heat from all sides. The facility, which will handle ten 70-ton cars at a time, will be used for ore moving to Escanaba for transfer to ore ships destined for steel mills in the Chicago and Lake Erie areas. The infrared principle of thawing is expected to result in more efficient and accelerated movement of iron ore and to permit an extension of the ore shipping season.

The Connellsville Manufacturing & Mine Supply Co. has changed its name to Connellsville Corp., Connellsville, Pa. The company was founded in 1901 to exploit the ideas of the late Daniel F. Lepley for a self-bottoming mine skip. In addition to coal mine skips, it produces mine hoists, mine elevators, car cages, portal mine cages, rotary dumpers, automatic skip loaders, trip feeders, reversible spraggers, and car hauls. Connellsville is also a producer of materials handling equipment for non-recovery coke ovens.

National Gypsum Co. has acquired the Allentown Portland Cement Co. of Allentown, Pa., in an exchange of stock. The move added three plants to National Gypsum's operations, increasing its cement-making capacity to 16,500,000 bbl a year.

A new image of coal is being promoted by Chesapeake & Ohio Railway in an advertising campaign. It stresses new advantages of coal brought about through modern techniques and advanced combustion equipment. Coal's large reserves, economy and cleanliness are also key points of the campaign. C&O hopes to increase the market in industry, schools, hospitals, government buildings and remodeled or enlarged facilities.

The American Brass Co., one of the Nation's largest copper and brass mill product manufacturers, has officially changed its name to Anaconda American Brass Co. It is a wholly-owned subsidiary of the Anaconda Co. The name change was made to identify its brand name with its company name.

Peabody Coal Co. is opening a new coal mine near Moxahala, Ohio. Construction is in the preliminary stage, but a considerable tonnage is expected early in 1961.

American Cyanamid Company's plant at Latrobe, Pa., has been cited by three different organizations for operating more than 16 years without a lost-time accident. Plant personnel recently received the Award of Honor of the National Safety Council, a Certificate of Achievement from the Manufacturing Chemists' Association, and Cyanamid's own President's Safety Award. The Latrobe plant manufactures blasting caps for detonating dynamite charges.

The Tennessee Valley Authority plans to use record-breaking 800,000-kw generating units in a new plant which may be located in southeastern Kentucky. TVA anticipates it will be necessary to start construction of the first unit next summer to help meet the region's growing power demands. The unit would be operating in 1964 and would use more than 2,000,000 tons of coal per year. No site has been selected for the new plant, but current plans contemplate a location to assure maximum use of the extensive coal reserves in eastern Kentucky and adjoining states.

Republic Steel Corp.'s iron mine at Lyon Mountain, N. Y., closed since July 3, was reopened October 3 on a limited scale. The company plans to recall between 80 and 100 men and use one shift in the mines, one in the mill and two shifts at the sintering plant.

Wheeling Steel Corp. has recently announced its No. 3 battery of 51 coke ovens at Steubenville, Ohio, has been taken out of service for a rebuilding project which will require a year to complete.

For loading in seams 40" and up ...coal, potash, gypsum, salt

22689

Goodman 967 loader

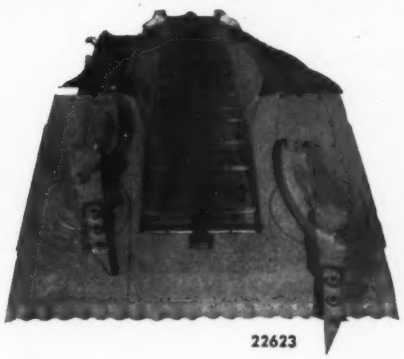
Capacity—30" wide, 8" deep conveyor with a rugged 2¼" pitch chain provides plenty of room and moving speed for the lump or fine material loaded by the fast working gathering arms.

Maneuverability—gear driven, clutch controlled tramming eliminates need of reversing tram motors electrically—permits fast loading movements at the face.

There are other reasons too, for the success of the 967; in fact, for all of the Goodman 960 series loaders:

- simple contactor control because of one-direction, continuously operated tram motors—electrical maintenance is extremely low.
- four interchangeable motors for all machine functions.
- motors and contactor case up out of bottom muck and water.
- rugged, heavy construction with solid footing for stability in heaviest kind of loading and strong crowding effect.

Your Goodman sales engineer will be happy to give you the full story on the 967 or any other loader in the Goodman line.



22623

Basic height—30" or 38" Conveyor—30" wide

Rated capacity—15 to 20 tpm

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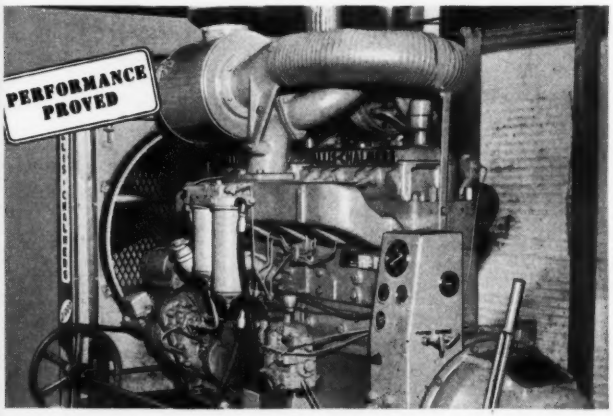
Halsted Street and 48th Place, Chicago 9, Illinois

CUTTING MACHINES • CONVEYORS • LOADERS
SHUTTLE CARS • LOCOMOTIVES • CONTINUOUS MINERS

Use Genuine Goodman Replacement Parts

EXCAVATOR-CRANES — The 21000 gives Koehring's Model 1205 the kind of dependable power needed for demanding shovel-crane service.

OFF-HIGHWAY TRUCKS — Repowered with a 21000, this truck now works faster — hauls an extra 50 tons an hour — and uses no more fuel to do it.



PUMPING—One of the advantages of the 16000's and 21000's on any application is their sure, unusually fast starting—even in sub-freezing temperatures.

AC diesels prove themselves in all types of equipment

16000 230 HP

21000 (turbocharged) 340 HP

The amazing Allis-Chalmers 16000 and 21000 diesels are exceeding expectations wherever they are used.

Lowest fuel consumption — by far — The turbocharged 21000 uses as low as .355 lb of fuel per hp-hr — 8 to 27 percent less than any other engine in the field — by published claims! The saving is 1 to 2½ gal. in every 10. Buying fuel, hauling it or storing it, that represents important money.

Stamina to match — These diesels were actually operated at full load with half the rod and main bearings cut away . . . deliberately run hot and with only partial lubrication . . . operated with imbalances and intentionally weakened parts. Their stamina was tested far beyond toughest actual use. Reports from hundreds of engines in the field confirm the difference between these great diesels and others.

Power is THERE — at full throttle and at continuous rating. Torque is consistently high — to make any equipment perform at its best.

Superior starting — starts quickly and gets on the job — even at sub-freezing temperatures — without the use of starting aids.

Let us tell you more about these *modern* diesels with their cleaner, tougher, more serviceable design. Allis-Chalmers, Milwaukee 1, Wisconsin.

BE-208

ALLIS-CHALMERS

ELECTRIC SETS — The quick-response 16000 and 21000 diesels — drive brushless generators which offer many electrical and mechanical operating advantages.

◀ **AIR COMPRESSORS** — The 16000 diesel brings to Davey compressors the advantages of economy, dependability, ease of servicing, and high power availability.

An automatic coal sampling device which will be of benefit to producers, shippers and consumers of bituminous coal has been successfully tested at the Chesapeake & Ohio and Baltimore & Ohio railway piers in Toledo, Ohio, according to A. K. Greene, vice president of Oglebay Norton Co. of Cleveland and chairman of a special committee of coal producers, shippers and consumers who have been working on the project. The device, which has been under study for the past three years, will automatically secure samples from rail cars as the coal is loaded aboard ship. It consists of three steel tubes mounted on the cradle of the dumping machine. Samples of coal are collected in openings in these tubes and removed for laboratory analysis.

The Glen Rogers mine of Raleigh-Wyoming Mining Co. has been closed indefinitely. Located in Wyoming County, W. Va., the shaft operation was originally opened in 1920.

One of the world's largest generator units has been put into operation at TVA's Widows Creek steam plant in northern Alabama. The 500,000-kw unit will consume 1,500,000 tons of coal a year. A second unit of similar capacity has been authorized for the plant and is scheduled for completion in 1963.

Blue Crystal Mines of Killbuck, Ohio, has put a new ten-yd dragline into operation. The machine will be used on 3000 acres of strip mining land owned or leased by the coal mine operators.

As the latest step in a broad modernization program at its Fairfield, Ala., tin mill, Tennessee Coal & Iron Division of U. S. Steel Corp. will install a new six-stand, 52-in. cold reduction mill. Scheduled for completion in 1962, the mill will enable TCI to fulfill the rising demand for thinner and wider tin plate.

BOOK REVIEW

WIRE ROPE STANDARDS FOR MINES

American Standards Association has announced the publication of "Specifications For and Use of Wire Ropes for Mines, M11.1–1960." Sponsored by the American Mining Congress and the Wire Rope Technical Board, the standard outlines good practice in the selection and use of wire rope for both deep and strip mines. Copies are available from ASA, 10 East 40th Street New York 16, N. Y., at a cost of $5.00 per copy.

Yieldable Arches GIVE when the "squeeze" is on

Heavy or shifting ground around a mine opening always needs some form of support, to give the overburden a chance to settle naturally into a pressure arch. Mining men have found that the best type of support is one which will yield slowly to the pressures until the natural arch is formed; rigid sets simply cannot stand up under the squeeze of the dynamic forces.

HOLDS FAST UNDER NORMAL LOADS

Bethlehem's Yieldable Arch works on a principle of sliding joints, which are formed by the lapping of one U-shaped segmental steel section over another as shown in the illustration. Husky U-bolt clamps are installed in pairs over the lapped joints, and drawn up tightly enough to hold fast under normal loads. As pressures bear down, however, the arch yields, a little at a time.

PRESERVES MINE SAFETY

The more the Yieldable Arch "gives," the more the stress is transferred to the surrounding material. Eventually, equilibrium is reached and the Yieldable Arch stands pat, its structural integrity maintained and mine safety preserved. That is why you will hear it said that the yielding feature of the Arch is more important than its physical strength.

The Yieldable Arch can only be highlighted here, of course; there is much more you will want to know. Its ease of installation, for example, and its high degree of recoverability. You'll be interested too, in knowing, that many Yieldable Arch installations have paid for themselves in months! A Bethlehem engineer will gladly discuss the full story in terms of your own special problems. Just write to the address below.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

ALSO . . .

Construction has begun on a multi-million dollar coal cleaning and preparation plant at Eastern Gas & Fuel Associates' Federal No. 1 mine at Grant Town, near Fairmont, W. Va. Contract for building the new plant has been awarded to Roberts & Schaefer Co. Scheduled for completion in December 1961, it will have a capacity of 12,500 tpd of coal and will utilize dense medium, table and froth flotation circuits to clean the Pittsburgh seam coal. The new plant represents the final stage in an improvement and expansion program at Federal, which has been one of Eastern's high capacity mines for many years. A new shaft, skip hoist, and auxiliary facilities were completed in 1958 to increase the mine's capacity. Last year approximately 600 large mine cars were acquired. Eastern operates mines in northern and southern West Virginia and central Pennsylvania. The new Federal project is the newest in a series of modern cleaning plants which have been installed at company mines.

The Delaware & Hudson Co. has sold the property and assets of its Hudson Coal Co. to Glen Alden Corp.

Lynx Yellowknife Gold Mines has granted a working option on its Mattagami area copper prospect in northwestern Quebec, Canada, to the Southwest Potash Corp., a wholly-owned subsidiary of American Metal Climax. The latter has agreed to spend $150,000 on the property during the next five years, and to carry out one year's assessment work exclusive of diamond drilling.

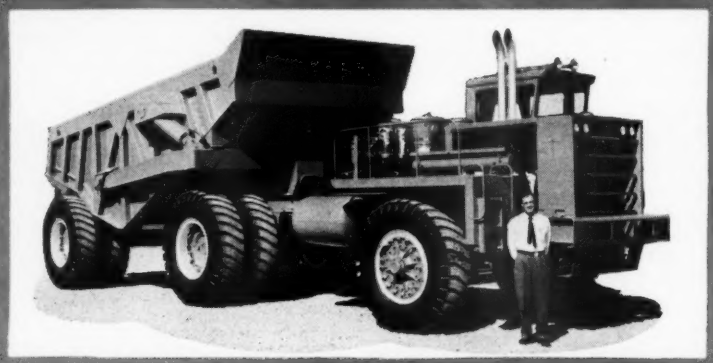
Chesapeake and Ohio Railway has become the first U. S. carrier to establish a contract rate on coal with a shipper under which a lower transportation rate is given in return for a guaranteed percentage of the shipper's tonnage. A recent contract between the C&O and Kentucky Power Co. provides a reduction under the regular transportation rate on coal received at the Kentucky Power electric plant now being built at Big Sandy, Ky., with C&O assured at least 80 percent of the annual coal traffic to the plant. Coal tonnage at the new plant is expected to be about 600,000 tons yearly.

A 136-acre tract of land in Cambria County, Pa., between Johnstown and Windber, has been donated to the University of Pittsburgh by Wilmore Coal Co. as a new site for its Johnstown College. Wilmore is an affiliate of the Berwind-White Coal Mining Co.

The erection of a new 65-yd stripping shovel at Peabody Coal Company's Bevier mine near Macon, Mo., is nearing completion. It is expected to be in operation sometime in November.

Research on the rare earth ore bastnasite will be continued and expanded at Pennsylvania State University under the sponsorship of Molybdenum Corporation of America. The research will continue to investigate new uses for the rare earths and the preparation of new rare earth products.

NEW PEAK in PAYLOAD!!



Introduced at the Mining Congress Convention this October, KW-DART'S 95EDT is the company's latest contribution to the mining industry. Its payload is 95 tons.

This tractor-trailer, the 70EDT, is a 70 ton hauler that has established enviable performance records in a number of mines in recent years.

The 50EDT carries 50 tons as a tractor-trailer. It utilizes KW-DART'S popular 25SL as a tractor. Its enthusiastic approval by mining operators fostered development of the larger units.

KW-DART CLIMAXES 57 YEARS OF ENGINEERING WITH THREE HIGH CAPACITY TRACTOR-TRAILERS

A new concept in heavy duty haulage was born with KW-DART'S tractor-trailer design. It enables moving greater tonnages with negligible sacrifice of maneuverability and without added horsepower.

These tractor-trailer combinations utilize KW-DART'S proved components, *engineered to your job.*

KW-DART TRUCK CO.

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THE REPORT CORNER

Recent Publications of Interest to Mining Men

U.S.B.M. Bulletin 587, "Design of Underground Openings in Competent Rock," by Leonard Obert, Wilbur I. Duvall and Robert H. Merrill. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 30 cents.

U. S. Geological Survey Circular 293, "Coal Resources of the United States"—a reprint of the progress report published in 1953—Free on application to the Geological Survey, Washington 25, D. C.

U. S. Geological Survey, "A Primer on Water," by Lund B. Leopold and Walter B. Langbein. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 35 cents.

"Tungsten Mines of Colorado," by State of Colorado Metal Mining Fund. Free on application to the Metal Mining Fund, 204 State Office Building, Denver 2, Colo.

Special Report 62, "Geology of the Orchard Peak Area," by Owen T. Marsh. California Division of Mines, Ferry Building, San Francisco, Calif. Price $1.00.

Report of Investigations No. 38, "Coal Resources of the Upper Part of the Monongahela Formation and the Dunkard Group in Ohio," by George H. Denton. Ohio Division of Geological Survey, Orton Hall, 155 So. Oval Drive, Columbus 10, Ohio. Price 52 cents.

Bulletin 58, "Coal Resources of Ohio," by Russell A. Brant and Richard M. DeLong. Ohio Division of Geological Survey, Orton Hall, 155 So. Oval Drive, Columbus 10, Ohio. Price $2.06.

U.S.B.M. Report of Investigations 5653, "Preparation Characteristics of Coal from Marion County, W. Va.," by T. E. Gray and E. R. Palowitch.

U.S.B.M. Report of Investigations 5654, "Nitric Acid Oxidation Rates for Selected Coals and Related Substances," by J. B. Gayle and A. G. Smelley.

U.S.B.M. Report of Investigations 5657, "Rapid Evaluation of Spodumene and Kyanite Samples by Heavy Liquid Separation," by James S. Browning and John B. Gayle.

Note: U.S.B.M. Reports of Investigations can be obtained from the Publications-Distribution Section, Bureau of Mines, 4800 Forbes Ave., Pittsburgh 13, Pa. They should be requested by number and title.

40 STORIES *from Pit to Surface*

...IT'S R/M CONVEYOR BELT FOR LONG LIFTS!

Easy troughability, flexibility, super-strength synthetic cords, high wear-resistance—make R/M Conveyor Belts ideal wherever long lifts at high tensions are required. The installation shown here, for example, was a quarter-mile conveyor with a lift from pit to surface loading station nearly as high as a 40 story building. An R/M conveyor belt made an exceptional record on this rugged haul. There's an R/M heavy duty conveyor belt for every materials handling requirement . . . each engineered to haul fuller, heavier loads—and *last longer*. With proper engineering, for example, you can increase hauling capacity up to 60% with Ray-Man Conveyor Belt and 45° idlers! Ask your R/M representative about other R/M Conveyor and elevator belts, about advantages of extra-flexible, double compensated, rip-resistant Ray-Man . . . about Homocord, the extra-cushioned belt for unusually abusive shock loading conditions, or about the Wedlok metal fastener splice which avoids vulcanizing splices. Any R/M Conveyor Belt with "XDC" cover means extraordinary resistance to wear and tear, longer life—"More Use per Dollar." Write for Bulletin M302 and Catalog CB25.

ENGINEERED RUBBER PRODUCTS ..."MORE USE PER DOLLAR"

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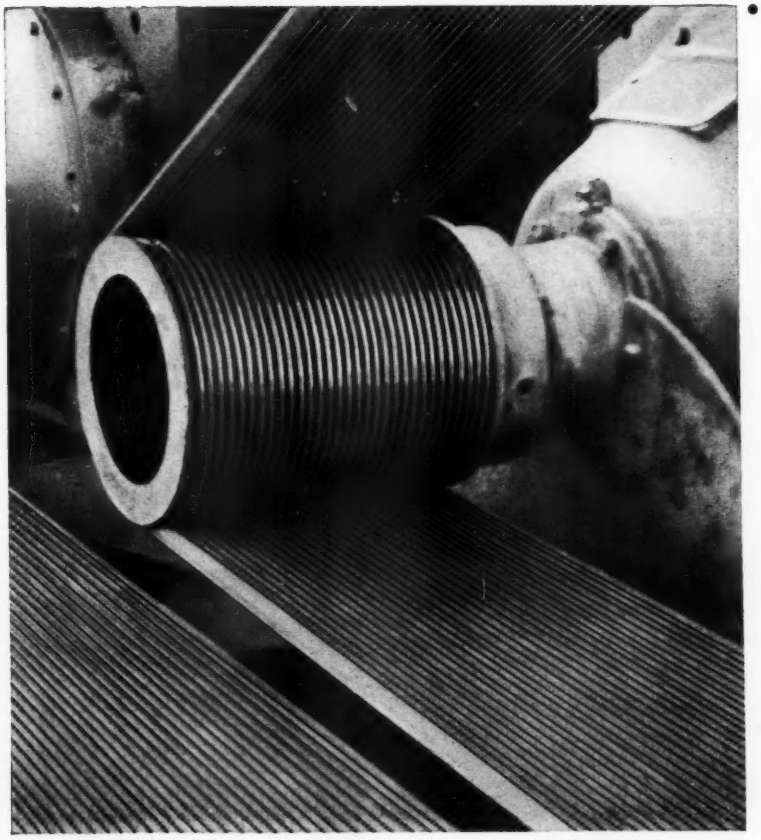
RAYBESTOS-MANHATTAN, INC.

MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY



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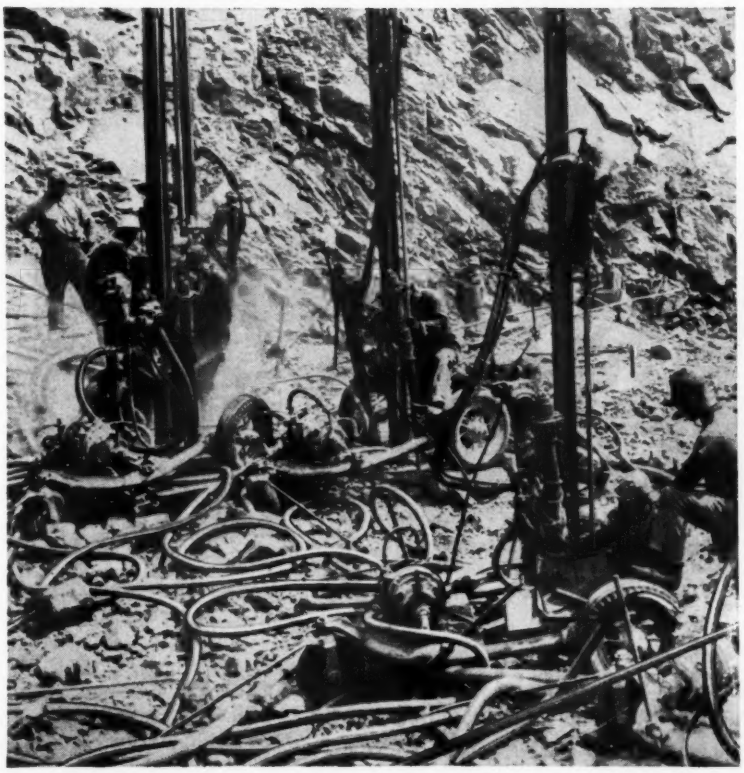
More Power— in *Less* Space ... *with Reliability*

A *single unit* V-ribbed belt across full width of the drive-sheave—*not* an assembly of V-belts—enables patented Poly-V to deliver much *more* power in the same space as a V-drive . . . or *equal* power in much *less* space! Single unit belt design also eliminates belt "length matching" problems ... minimizes equipment down-time and belt replacement costs. Belt speed ratios remain constant from *no* load to *full* load to provide the smoothest running, coolest running—*longest wearing* drive you can install. Maintain groove shape. Just two sections of Poly-V Belt meet every heavy duty power transmission requirement. Write for Bulletin M141, or call your R/M Distributor.

CONVERT TO RM POLY-V and BE SURE!



HOMOFLEX HOSE *more flexible, weighs less than any hose for equal pressure*

- **SUPER-STRONG**
- **PRECISION BUILT**
- **NO PRE-SET TWIST—WILL NOT KINK**
- **INSEPARABLE TUBE-TO-COVER BOND**
- **UNIFORM INSIDE AND OUTSIDE DIAMETERS**
- **EASIER, SAFER COUPLING**

Strong, lightweight, and "flexible as a rope"—Homoflex is the easiest handling hose and lasts longer. Made in types for air, water, other fluids and gases. Ask about other types of R/M rubber hose for your job applications. Write for Bulletins M620 and M694.

MOLY ALLOYS MEAN LONGER LIFE WHERE YOU NEED IT MOST

In the mine, in the pit, in the quarry . . . the payoff is at the point of hardest wear. Specify long life molybdenum-containing alloys in your equipment and you immediately cut down the number of shutdowns for part replacement, and increase productivity without boosting capital investment.

You can satisfy just about every high wear rate application with one of the four grades developed by Climax . . .

For gouging abrasion plus impact, **use 12-2 alloy.**

For grinding abrasion, **use chrome-moly steels.**

For scratching abrasion and erosion, **use 15-3 alloy.**

For general purpose abrasion resistance, **depend on 3-2-1 alloy.**

All four have been proved in years of actual mining use. Make sure your equipment benefits by these advanced materials.

Complete details are in "The Role of Molybdenum In Abrasion Resistant Materials", available on letterhead request. Climax Molybdenum Company, 1270 Ave. of Americas, New York 20, N. Y.

CLIMAX MOLYBDENUM

CLIMAX MOLYBDENUM COMPANY
a division of AMERICAN METAL CLIMAX, INC.

NEWS and views

Sign 20-Year Power Pact

A 20-year power contract has been signed between the Bonneville Power Administration and Webb & Knapp, Inc., which plans to use the power in connection with a process to recover iron from copper slag. The contract, which begins in 1963, provides for furnishing up to 120,000 kw of electricity for a 350,000 ton per year steel plant Webb & Knapp proposes to erect at Anaconda, Mont., to salvage iron from a 40,000,000-ton slag dump owned by the Anaconda Co. Webb and Knapp has contracted to buy, for 25 cents a ton, all the slag in the dump and the future output of Anaconda's smelter, adjoining which the new mill will be built. The plant, cost of which is expected to be in excess of $30,000,000, will be operated by Webb & Knapp Strategic Corp., owned 85 percent by Webb & Knapp and 15 percent by Strategic Materials Corp., the latter of which developed the recovery process. Webb & Knapp also plans a similar operation at Clarkdale, Ariz.

To Develop New Zinc Find

Underground development work recently began at the Stevens County, Wash., operations of Goldfield Consolidated Mines Co. near Leadpoint. The company plans to drive a 1500-ft drift from the bottom of the 100-ft deep Anderson open pit, which closed down in 1952, to develop three zinc ore bodies said to have been discovered by diamond drilling during the past three summers. The drift will be 15 ft by 15 ft, driven at a grade of about minus 10 percent; this will permit utilization of diesel-powered trucks for haulage from underground. A fourth ore body, estimated to contain about 1,000,000 tons of zinc ore, could be mined by open pit methods. Expenditures for developing the deposits are reportedly expected to reach about $500,000. The company is said to be considering erection of a 1500-tpd mill at the property pending outcome of the current work.

Acquires Book Cliff Coal

Minerals Development Corp., a Colorado company and subsidiary of Heiner Coal Co., recently acquired the holdings of Book Cliff Coal Co. in Emery and Carbon Counties, Utah. Terms of the transaction were not disclosed, but the acquisition includes equipment, coal contracts and 320 acres of coal lands in Emery County and half interest in 2400 acres of leased coal lands in Carbon County. The company was also said to have purchased the other half interest in the Carbon County property in a separate deal. Coal production from the Book Cliff mine in 1959 was about 68,000 tons, used primarily for industrial, noncoking purposes in western mines and smelters.

Lead Purchase Contract

Bunker Hill Co. and National Lead Co. have entered into a contract effective January 1, 1961, whereby National Lead will purchase primary lead, special high grade zinc, and cadmium produced at Bunker Hill's Kellogg, Idaho, operations. The contract covers Bunker Hill's entire production of these metals except for calking lead and that required by the Pacific Division (formerly Fabricated Products & Chemicals Division) of the company. Earlier this year, the Government decreed that a contract which Bunker Hill had with St. Joseph Lead Co., covering lead sales, could not be renewed beyond December 31 and the company therefore had to seek other outlets for the metal. National Lead will retain the Bunker Hill brand name.

Joint Venture Announced

Minerals Engineering Co. and Susquehanna-Western, Inc., a subsidiary of the Susquehanna Corp. have formed a joint venture operation to produce vanadium pentoxide, a steel alloying material, in a newly acquired plant near Salt Lake City, Utah. Terms of the agreement were not disclosed. A new process, said to be the first of its kind in the United States, will be employed to chemically extract vanadium from vanadium-bearing slag, a heretofore wasted by-product of western phosphorous operations. Minerals Engineering is engaged in the production of tungsten and in the mining and treatment of vanadium-bearing uranium ores. Susquehanna, a manufacturer of metallurgical and chemical products which is also engaged in other fields, is presently a producer of vanadium.

Wyoming U_3O_8 Mill Planned

Petrotomics Co. is proceeding with plans to erect a 500 tpd uranium processing mill in the Shirley Basin of Wyoming. The company, a recently formed partnership between Kerr-McGee Oil Industries, Inc., Skelly Oil Co., Getty Oil Co., and Tidewater Oil Co., will process its own ore and any custom ore directed to the mill by the Atomic Energy Commission. The mill would be built to process ore in the 1962 to 1966 period, for prior to 1962, AEC has the option of directing ore to existing mills.

Petrotomics' Shirley Basin ore reserve is currently being stripped of 120 ft of overburden in an area 600 ft wide and 800 ft long. It is expected that the first load of uranium ore will be shipped to a mill for processing late this year. The company's contract with the AEC provides for sale of 1,024,000 lb of U_3O_8 ore prior to March 31, 1962, and for the subsequent period ending December 31, 1966, it provides for the sale of U_3O_8 at the rate of 665,000 lb per year. Tidewater Oil Co. was recently appointed acting manager for the company's Wyoming mining activities.

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Teeth that really dig

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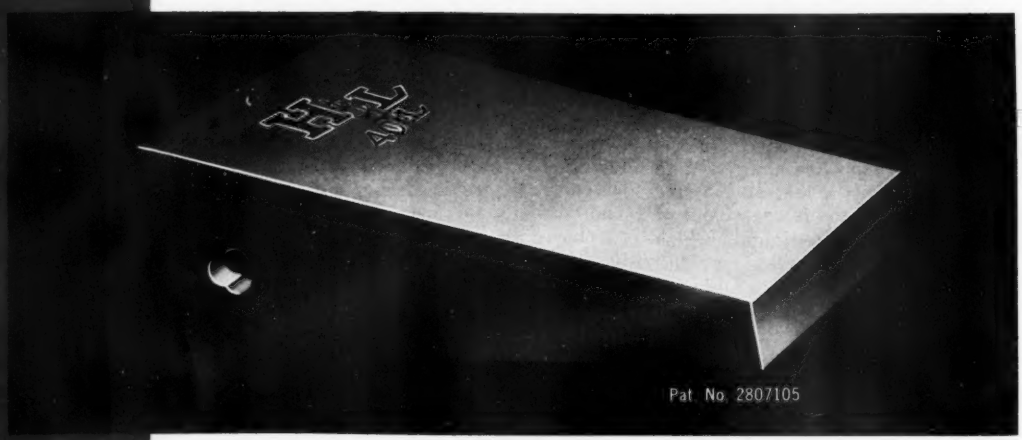
ALL FORGED

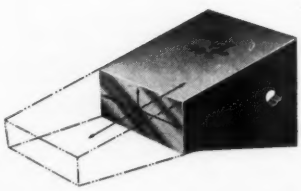
ONE PIECE REPLACEABLE POINT



A ONE PIECE FORGING OF...

HIGH ALLOY SUPER STEEL

LASTS AND LASTS



FORGING GIVES CONSISTENT GRAIN FLOW WITH CONSTANT HARDNESS FROM CORE THROUGHOUT POINT.

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MONTEBELLO, CALIFORNIA

30 YEARS OF EXPERIENCE DEVOTED EXCLUSIVELY TO THE MANUFACTURE OF DIGGING TEETH

ALSO . . .

Production is expected to be resumed next year at the Valley County, Idaho, rare earth placer operation of Porter Brothers Corp. The company in the past sold rare earths to the Government for its stockpile, but will now sell its production on the free market.

Clayloon Uranium Co. has placed its lead-zinc gravity-type concentrator located near Leadpoint, Wash., in operation on a test basis. The mill is treating ore from the Lead Trust and Lead King open pit mines which were acquired by the company within the past 15 months.

An option on the Scranton mine at Central, Utah, is reported to have been taken by the Anaconda Co. The property, owned by McFarland & Hullinger, consists of 21 claims from which about 60,000 tons of lead and zinc ores had been shipped prior to 1955. It is expected that geological mapping and sampling will be conducted.

Production has been resumed at the Camp Bird mine of Camp Bird Colorado, Inc., near Ouray in southwestern Colorado. A 500-tpd mill at the site will produce zinc, lead and copper concentrates. It is reported that the company has signed a long term agreement with American Smelting & Refining Co. for processing the concentrates at the latter company's Amarillo and El Paso, Texas, plants.

Triton Mining Co. is planning to install a 65-tpd mill at its Schumaker property near Colville, Wash., for treating zinc ore from a deposit which was revealed through core drilling last summer. The company expects to drift about 115 ft to the ore body, which is believed to be about 12 ft wide and is assertedly high grade.

Shaft sinking operations were reportedly to be started on November 1 at the Stauffer Chemical Company's Green River, Wyo., trona property. The project, to be completed in 1962, calls for bringing the mine into production, erecting a refinery with an initial annual capacity of 150,000 to 200,000 tons, and constructing a railroad to the site.

Six thousand employes of American Smelting & Refining Co. are now covered by one-year extensions to two-year contracts negotiated in 1959 with the International Union of Mine, Mill & Smelter Workers. Extension of the contracts to June 30, 1962 affects Asarco properties in Denver and Leadville, Colo.; Baltimore, Md.; Perth Amboy and South Plainfield, N. J.; East Helena, Mont.; Omaha, Neb.; Los Angeles, San Francisco and Selby, Calif.; El Paso, Texas; Tacoma, Wash.; and Hayden, Ariz.

STATEMENT, REQUIRED BY THE ACT OF AUGUST 24, 1912, as amended by the acts of March 3, 1933, July 2, 1946 and June 11, 1960 (74 Stat. 208) showing the ownership, management, and circulation of MINING CONGRESS JOURNAL, published monthly at Washington, D. C. and Lancaster, Pennsylvania, for October 1, 1960.

1. The names and addresses of the publisher, editor, managing editor, and business manager are:

Publisher, The American Mining Congress, Washington, D. C.

Editor, Robert W. Van Evera, Washington, D. C.

Managing Editor, George W. Sall, Washington, D. C.

Business Manager, P. D. McMurrer, Washington, D. C.

2. The owner is: The American Mining Congress, a corporation not for profit, Washington, D. C. No stockholders, President, Raymond E. Salvati, Huntington, West Virginia,; Executive Vice-President, Julian D. Conover, Washington, D. C.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required by the act of June 11, 1960 to be included in all statements regardless of frequency of issue.) 17,450

ROBERT W. VAN EVERA,
Editor.

Sworn to and subscribed before me this 16th day of September, 1960.

KATHRYN A. HATHAWAY,
Notary Public.

(My commission expires July 31, 1962.)

A 4½-year redevelopment program at the Manhattan, Nev., gold property of White Caps Gold Mining Co. is nearly complete. The company has spent about $330,000 for dewatering, retimbering and general cleanup. A drilling station for a two-stage drilling program was recently completed, and equipment is being assembled to drill into an extension of gold ores that produced between $5,000,000 and $7,000,000 in gold from previous operations. Second phase drilling will be conducted in an effort to reestablish contact with known values lost through a cave-in several years ago. This vein was 34 ft wide and is said to have carried 2¾ oz of gold per ton. White Caps also reports that its beryllium property at Lone Pine, Calif., is responding to development.

Lead smelting operations at the Arkansas Valley Smelter of American Smelting & Refining Co. at Leadville, Colo., will be suspended December 31, 1960. A declining ore supply was given as the reason for suspension of smelting activities. It is undertood that Asarco will continue an active ore buying program in Colorado and that lead ores and concentrates previously handled at Leadville will now go to the company's El Paso, Texas, smelter. The Arkansas Valley plant has been in operation since 1879. About 170 employes will be affected.

A 35,000,000-ton coking coal reserve in Carbon County, Utah, will be acquired from Heiner Coal Co. according to plans of Pacific States Steel Co. The company holds options on about 5700 acres of coal property that would be acquired from Heiner under terms which were not disclosed. Pacific needs the coking coal for an integrated steel plant it is building near Hayward, Calif. No announcement was made as to where the coal would be coked, but the Carbon County properties have been surveyed as a possible site.

Nearly $12,000,000 were spent by International Minerals & Chemical Corp. for plant additions, expansion and improvements in fiscal 1959–60, according to the company's annual report. Largest expenditure was $6,100,000 that went toward completion of the potash mine and refinery of IMC's Canadian subsidiary at Esterhazy, Saskatchewan. This mine, when completed in fiscal 1961–62, will "open up the world's largest known source of high grade agricultural potash." At Houston, Texas, IMC has begun construction of a $500,000 mill for grinding barite which is used in oil well drilling mud.

About 600 men have returned to work at the Sunnyside, Utah, coal mines of Kaiser Coal Co. The men had been laid off for about one month because of slack business.

The first shipment of uranium ore during 1960 has been made from the Dahl lease of Daybreak Uranium, Inc., in the Mount Spokane (Wash.) district. Ore from an 800-ton stockpile is being shipped by truck to Dawn Mining Company's processing mill at Ford. The ore is from a zone discovered by exploratory drilling and is about 350 ft from the original 1955 discovery. The deposit, which has been exposed on two sides of a ridge, appears to be about 60 ft long, 12 ft wide, and 5 ft thick. The contractor plans to mine through the ridge by tunneling.

A 200,000 bbl bulk cement storage plant is being built in Portland, Ore., by Ideal Cement Co. The plant will have six 123-ft by 40-ft diam concrete silos; eight bulk loading bins; and barge, ship and rail unloading facilities as well as facilities for bulk loading or package loading of trucks, rail cars, and barges. Cost of the project will exceed $2,000,000.

WHEELS OF GOVERNMENT

(Continued from page 103)

basic and 3 additional maximum objectives."

While all basic objectives are not filled, the OCDM report indicates that the stockpile generally is in good shape to meet any potential wartime or emergency demands.

EQUIPMENT MANUFACTURERS AIR EXPORT PROBLEMS

At a recent conference in Washington, representatives of the mining equipment manufacturing industry outlined to Department of Commerce officials the handicaps they encounter in seeking to expand their export business. They also suggested steps to improve this trade, which last year amounted to $50 million.

Spokesmen for the mining machinery industry said that tariffs, quotas, licensing and exchange controls, and government "red tape" encountered abroad in the processing of import licenses are the principal handicaps to foreign sales. They also said that if their export business is to be expanded, they must be able to offer more liberal long-term credits to purchasers. The industry representatives pointed out that in some instances domestic concerns are only able to hold foreign business by setting up subsidiaries in other countries.

The material assembled at the industry meetings is being used by U. S. officials in discussing trade restrictions with other countries.

PUT AN EXTRA SOMETHING IN THEIR PAY ENVELOPES

It could be the biggest bonus you ever gave your employees—life-saving facts about cancer. Whether you have a factory or an office—a hundred or a thousand employees—we are prepared to offer a cancer education program to meet your particular requirements. Pamphlets, posters, films and speakers will bring vital information to your employees. Such programs pay off in saving lives. Call your local American Cancer Society for further information. Do it today.

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FOR COMPANIES OF EVERY SIZE

CMI COAL DRYERS

The Two Most Popular Sizes of CMI Continuous Centrifugal Coal Dryers

MODEL 36 (above)—65 TPH
COMPACT 26 (left)—20 TPH

Hundreds of installations prove that best results in centrifugal coal drying are obtained with CMI Dryers. CMI performance claims are conservative and correct.

GENERAL SPECIFICATIONS	COMPACT 26	MODEL 36
Conservative rating with feed of ¼ x 0 product at 35% surface moisture	20 tph	65 tph
Percent recovery of product	over 90%	over 90%
Percent surface moisture of discharge product	under 6%	under 6%
Horsepower consumption	10-15 hp	50 hp
Total machine weight, including motor	4700 lbs.	13,000 lbs.
Floor space required	59" x 59"	71" x 76"
Overall machine height	52"	80"
Motor specifications	15 hp; 1800 rpm	50 hp; 1800 rpm

For complete information, write for literature.

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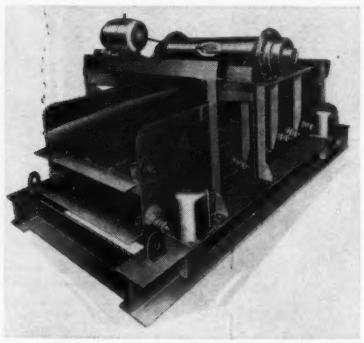
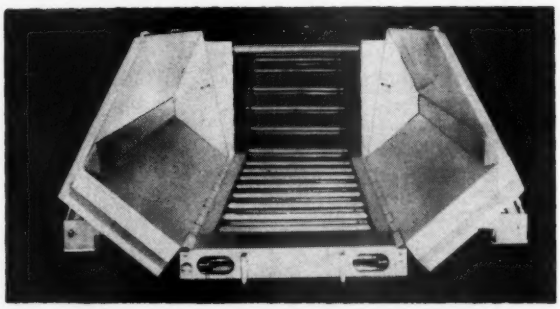
manufacturers forum

AN ENCLOSED SPRING AND RUBBER MOUNT SUSPENSION SYSTEM for Deister Vibrating Screens has been announced by Deister Machine Co., 1933 East Wayne St., Ft. Wayne 4, Ind. The suspension incorporates a heavy welded H-beam base, which

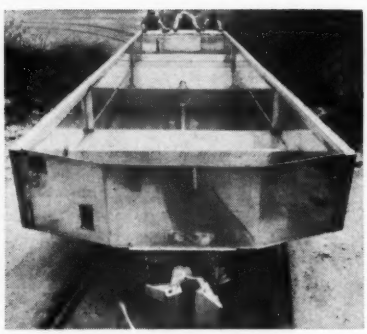


reportedly gives greater stability and provides what is said to be a substantial increase in solid or "dead" weight as compared to "vibrating weight." Only four mounts are used, one at each corner of the base, except for the largest screens which have an extra center mount on each side. Springs are located to the outside of the side plates and can be easily reached. Adjustments are made by tightening or loosening one nut and lock nut.

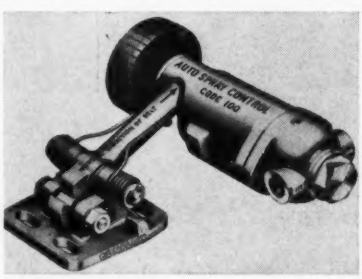
A TRANSFEEDER BELT AND CAR FEEDER, developed to accelerate shuttle car performance, has been introduced by National Mine Service Co., Indiana, Pa. The unit allows a shuttle car to discharge its load at maximum speed. The Trans-Feeder has a 300 cu ft capacity hopper. After accepting shuttle car's load it feeds it onto the belt or into a car at at any desired rate. Its sides raise to force coal or ore onto a center conveyor. Operation is completely automatic through one cycle and is initiated by the shuttle car operator. Available are three models ranging from 44 to 58 in. high.



AN ALL ALUMINUM MINE CAR weighing 4900 lbs and able to carry seven times its weight in payload was recently released by Irwin-Sensenich Corp., Irwin, Pa. The carrier has a welded aluminum body and aluminum trucks. Only the wheels, axles, and couplers do not utilize the light metal. It measures 25½ ft long and 6½ ft wide, stands 39 in. high, and has a capacity of 446 cu ft or approximately 14 tons.



AN AUTO SPRAY CONTROL offered by Megator Corp., 930 Manchester Ave., Pittsburgh 12, Pa., is designed to automatically control supplies of water and fluid sprayed

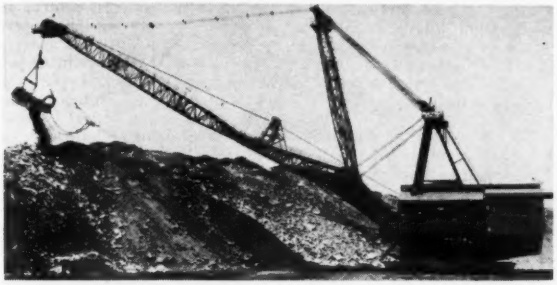


or sprinkled on transported materials such as asbestos, coal, coke, gravel. The unit is self-contained and an outside source of power is not required.

TWO REAR DUMPERS, designed to mining specification and featuring mining-duty components, have been introduced by Mack Trucks, Inc., Plainfield, N. J. They are the M-45SX

(left) a 45 ton, six-wheel unit with a 28-yd body, and the M-30X (right) a four-wheel vehicle with a 20-yd body. Both models feature an offset cab, providing a view fore and aft that reportedly enables easier spotting and faster cycling. Other cab features include a reverse slope windshield to reduce glare, reflection and dirt and dust accumulation; piano hinged doors, conveniently grouped instruments, and double vents. The M-45SX is powered by a naturally aspirated V-12 diesel engine developing 450 hp at 2100 rpm, while the M-30X features a six cylinder diesel engine developing 320 hp at 2100 rpm.

A LONG RANGE WALKING DRAGLINE, the Model 1250-W, has been introduced by Bucyrus-Erie Co., South Milwaukee, Wis. Largest B-E machine of its type, the unit has a 225-ft boom and 35-cu yd bucket and can strip overburden to depths of 130 ft.



ANNOUNCEMENTS

Vincent N. Burnhart has been elected president of **E. J. Longyear Co.,** succeeding the late Donald M. Davidson. Burnhart, formerly vice president and general manager, joined the company in 1946 and became manager of the Contract Drilling Division in 1947. He was named general manager in 1957 and became vice president in 1958. He is a director of the Longyear Co. and of Canadian Longyear Ltd. and is president of the Diamond Core Drill Manufacturers Association, an organization made up of leading U. S. core drilling equipment producers.

V. N. Burnhart

Longyear directors also named four new vice presidents including **Rudolph C. Gebhardt,** vice president, Mining; **Michal J. Gleason,** vice president, Contract Drilling; **Eugene Larson,** vice president, Marketing; and **John F. Hoffmeister,** vice president, Manufacturing.

George R. Fox, works manager of **Joy Mfg. Co.** plants in Franklin, Pa. since 1953, has been elected vice president of manufacturing, **Joy International, S.A.,** a wholly-owned subsidiary which guides the company's overseas operations from headquarters in Monaco. Fox will work on manufacturing matters with Joy's wholly-owned manufacturing subsidiaries in Australia, France, Great Britain and South Africa. He will also handle liaison between these operations and Joy's eight manufacturing plants in the United States.

Hendrick Manufacturing Co. Carbondale, Pa., has announced the appointment of **Kenneth H. Colville, Jr.** to the new post of Director of Sales & Marketing. He will be charged with the basic advertising and marketing strategy involved in the sales of Hendrick perforated metal screens, Wedge Slot screens, Wedge Wire screens, and other Hendrick products.

The appointment of **Will Mitchell, Jr.,** as acting director, Research Division, **Allis-Chalmers Manufacturing Co.** has been announced. He succeeds the late Dr. H. K. Ihrig, director of research and vice president of the company, who died August 22. Mitchell joined Allis-Chalmers in 1947 as director of the firm's basic industries laboratory and a short time later he was named research supervisor.

W. Mitchell, Jr.

Warren Engle was named District Manager of the Southeastern District of **Leschen Wire Rope Division, H. K. Porter Company, Inc.** He was formerly a sales representative for Wickwire Spencer Division of Colorado Fuel & Iron Co. His district includes North Carolina, South Carolina, Georgia, Florida, Alabama, Kentucky, Tennessee, Louisiana, Mississippi, and Arkansas, with headquarters at the new Leschen warehouse and district office at 1238 Fernwood Circle, N.E., Atlanta Georgia.

CATALOGS & BULLETINS

CONVEYOR, ELEVATOR AND TRANSMISSION BELTING. *The Boston Woven Hose & Rubber Div., American Biltrite Rubber Co., Boston 3, Mass.* In addition to detailed data of various types of belting, 36 page catalog contains illustration showing construction of each belt, and a section of the catalog is devoted to tables dealing with belt weights, belt gauges, fabrics, and belt recommendations.

COMPOSITION ANALYSIS. *Industrial Nucleanics Corp., 650 Ackerman Rd., Columbus 2, Ohio.* "AccuRay Continuous On-Stream Composition Analysis" is the title of a new brochure from this company which describes the principles upon which continuous, non-contacting measurement of fluids in pipes is achieved. The brochure also has sections devoted to the economic justification for this type of equipment, descriptions and drawings of the system components, and applications data. Ask for Bulletin CA-860.

CORE DRILL APPARATUS. *Soiltest, Inc., 4711 W. North Ave., Chicago 39, Ill.* The Acker Presidente, a core drill rig designed for rugged field service, very deep core drilling and versatile operation, is described in the company's Bulletin 31. The equipment is available in both skid-mounted and truck-mounted models and can be used to core to depths of 4500 ft. The new folder describes the rigs many special features and many of its related accessories.

HANDLING SYSTEMS. *The McNally-Pittsburg Mfg. Corp., Pittsburg, Kans.* Bulletin 760 describes various systems of handling railroad cars for loading material such as rock, gravel, coal, etc. Bulletin uses photographs, dimensions, drawings and specifications to give description of the company products such as Automatic Loading Systems, Car Hauls, and Car Retarders.

ENGINE PAMPHLET. *International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.* Pamphlet CR-764-K details 27 International diesel and carbureted engines in four, six and eight cylinder versions. The line includes 10 diesels (two of four-cylinder design and eight of six-cylinder). In the carbureted models, two are four cylinder units, 12 are of six cylinders and three are V-8 models. Hp ratings range from 16.4 to 385, weights from 279 to 6045 lbs.

STEEL GRATING. *Grating Sales, Dravo Corp., Neville Island, Pittsburgh 25, Pa.* Bulletin No. 1112, "Tru-Weld Grating and Stair Treads" describes characteristics of steel industrial grating and facilities for its manufacture and fabrication. Bulletin also contains specifications for ordering and applications for Dravo grating and stair treads such as conveyor systems, trench drainage systems, sinter and pelletizing plants, and walkways and stairs.

COAL AUGERS. *The Salem Tool Co., South Ellsworth Ave., Salem, Ohio.* Bulletin CD-100 describes Models 1400 and 1500 of McCarthy Coal Augers from Salem Tool. Cutaways are used to illustrate features of the units and photographs show the equipment at work. The units move from hole to hole under their own power on hydraulic skids. They load from either side and require only a two-man crew.

(Continued on next page)

(*Continued from previous page*)

PARALLEL SHAFT SPEED REDUCER. *Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.* Book 2719 describes Link-Belt's redesigned and expanded line of "balanced design" parallel shaft reducers in 57 sizes. Single, double and triple reduction units are available in capacities up to 2800 hp at high or low output speeds and ratios up to 292:1. Information is included for selecting the correct drive, and there are rating tables for thermal and mechanical hp ratings for each input and output speed. Load classes are shown for almost 250 driven machines. Overhung loads, extended shafts and outboard bearings, dimensions and actual ratios are included in additional tables.

GENERATOR SETS. *Advertising Dept., Detroit Diesel Engine Div., Detroit 28, Mich.* Entitled "GM Diesel Generator Sets for Standby and Continuous Off the Line Power," Form 8SA68 contains charts showing technical data on generator sets from 13.5 kw to 260 kw. Data includes: maximum kw and kva ratings; information and model numbers for radiator cooled and heat exchanger cooled sets; and engine data for Series 53, 71, and 110, including twins and "V" engines as well as in-line models.

ORE WASHING EQUIPMENT. *Eagle Iron Works, 274 Holcomb Ave., Des Moines, Iowa.* Bulletin 760 describes washing and dewatering equipment for ore and nonmetallic minerals including screw washers, log washers and water scalping-classifying tanks.

CRAWLER MOUNTED DRILLS. *Gardner-Denver Co., Quincy, Ill.* Bulletin CDAT-1 offers information on drill carriers, drill feeds and various types and sizes of drills. Combinations of this equipment are also graphically illustrated to show combinations for specific drilling application. Construction features, operating features, specifications are also presented in pictures and diagrams.

AIR VIBRATORS. *National Air Vibrator Co., 435 Literary Rd., Cleveland 13, Ohio.* Coal handling applications for Navco "long-stroke" air vibrators are described in Catalog #307 which shows installation pictures and application data. Applications include use in rotary car dumpers, high lift dumpers and side lift dumpers.

WELDING, BRAZING AND SOLDERING. *All-State Welding Alloys Co., Inc., White Plains, N. Y.* A 56-page catalog and instruction manual is being offered by the company detailing physical properties, major uses, application instructions, and techniques for welding, brazing, soldering, cutting and hardfacing by All-State's line of products. Charts and tables aid in summarizing alloy selection and properties, and products are indexed by major metal use. Manual is designed for the advanced welder or engineer as well as for the beginner.

ELECTRICAL OPERATORS. *Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.* Booklet B-7534 tells how to apply electrical operators for the remote control of circuit breakers.

HYDRAULIC PRODUCTS. *Vickers Inc., Div. of Sperry Rand Corp., Detroit 32, Mich.* Catalog 5001C introduces a line of new hydraulic products from Vickers including power packages, servo valves and systems, vane pumps, piston pumps, pressure controls and flow controls, directional controls, control assemblies, hydraulic motors, variable speed drives, hydraulic cylinders, and accessories. Each specific family of products is described in a separate section, keyed alphabetically for convenient reference. Photographs, tables, curves, and typical circuit diagrams help illustrate the bulletin.

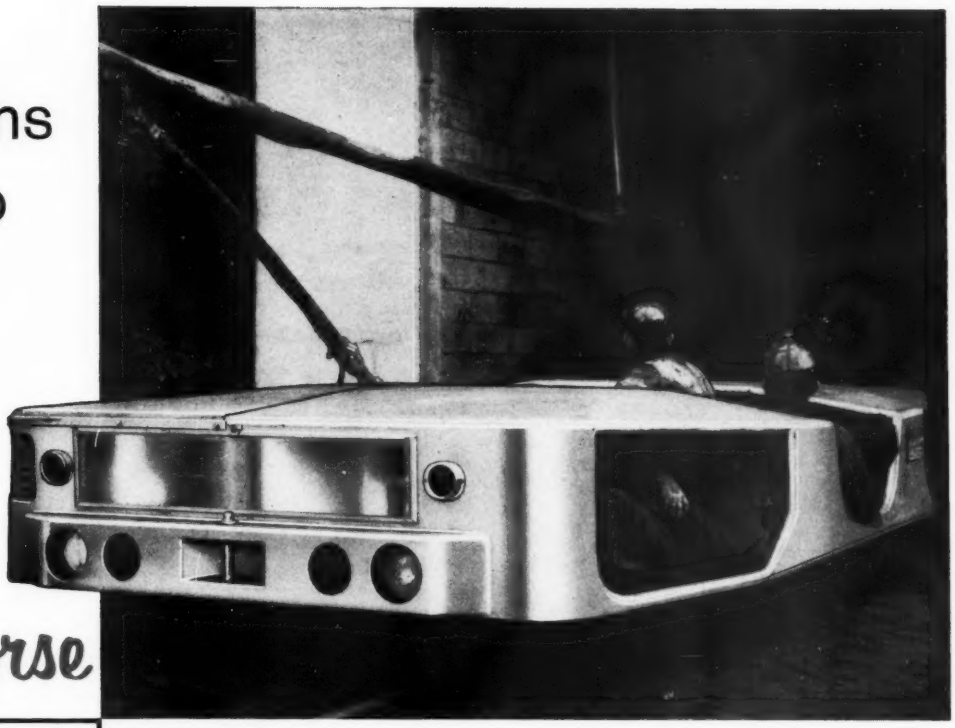
SCREW WASHERS. *McLanahan & Stone Corp., Hollidaysburg, Pa.* Bulletin SW-80 includes construction and design data, capacities, and dimensional drawings of the new series of single and double McLanahan screw washers. Significant design refinements claimed include improved direct drive, more efficient control of fines and modified rear gudgeon construction. Also, for the first time, the company offers a 44 in. by 33 ft single screw washer in this new series.

GAUGES, THERMOMETERS AND CONTROL INSTRUMENTS. *United States Gauge, Div. of American Machine and Metals, Inc., Sellersville, Pa.* Bulletin 3020 describes ten varieties of bourdon-tube type pressure gauges.

FRONT-END LOADER. *Caterpillar Tractor Co., General Offices, Peoria, Ill.* The Caterpillar 977H Traxcavator is the subject of Form 33790. Features described include a new turbocharged engine with horsepower raised to 150 from 100, a power shift transmission coupled with a speed range selector to give four speeds forward or reverse, a dry-type air cleaner, and a hydraulic system allegedly producing 27 percent greater pry-out force than earlier models. Bucket capacity has been raised from 2¼ cu yd to 2½ cu yd.

Index to Advertisers

Reasons why so many mines use the *Lee-Norse*



LOW mine portal bus

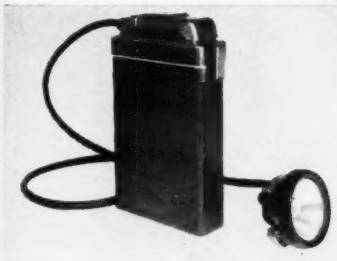
1. FAST—Cuts portal to portal time as much as 50%.
2. STREAMLINED—Transports 11 to 13 men in safety and comfort in low seams.
3. SAFETY—Exclusive split-roof allows operator full directional vision—trolley pole easily reached. Quick acting hydraulic truck-type brakes on each axle and on the traction gearmotor. Independent mechanical hand parking brake each axle.
4. POWERFUL—Self-propelled by sturdy traction-type 15 HP gearmotor (250 or 550V—DC).
5. RUGGED—Quality built to withstand the hard usage of 'round the clock mining!
6. LOW MAINTENANCE—Simple design—easy accessibility.
7. OPTIONAL FEATURE—Electric dynamic brakes for plus safety on severe grades.

LN

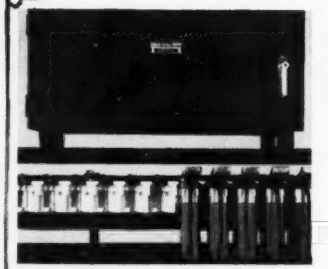
Lee-Norse Company

CHARLEROI, PENNSYLVANIA

Specialists in Coal Mining Equipment



☐ **NEW EDISON MODEL S ELECTRIC CAP LAMP** provides greater safety for the miner, higher production for the operator. 15% increase in illumination. Smaller, lighter-weight headpiece. Improved battery.



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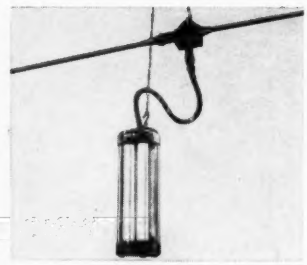

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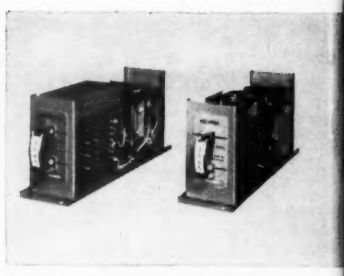


☐ **M-S-A® TRANSISTORIZED AUDIO TONE TRANSMISSION EQUIPMENT** permits economical centralized control and indication of fans, substations, motors, pumps, conveyor belts, switches, circuit breakers, and lights.

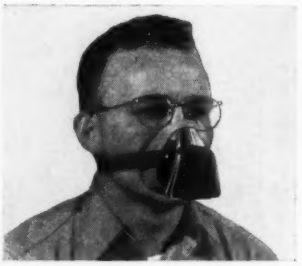
☐ **M-S-A® MINEPHONE** coordinates trip traffic for safe, fast, productive haulage control. Motormen have clear, instant voice communication with the dispatcher or other motormen while trips are moving. Installs easily.

☐ **M-S-A® THRU-STEEL* DUST COLLECTOR** sucks roof bolt dust through the drill steel. Speeds roof bolting operation and improves safety. Keeps up to or ahead of mining cycle. Fits any standard roof bolting machine.

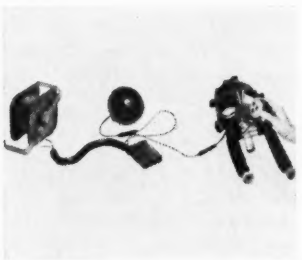
☐ **M-S-A® ALL-SERVICE® MASK** with new Window-Cator canister, external check valve and M-S-A Clear-tone Speaking Diaphragm gives dependable breathing protection against smoke, toxic gases and fumes.

☐ **M-S-A® CHEMOX® BREATHING APPARATUS** completely safeguards breathing while travelling through any gaseous or oxygen deficient area. Generates its own oxygen supply from replaceable canister.

☐ **M-S-A® SELF-RESCUER®** gives immediate breathing protection in emergencies caused by fire or explosion. Compact. Lightweight. Can be stored without deterioration. Available in storage cases or individual carrying cases.



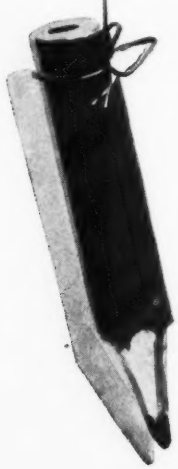
☐ **M-S-A® DUSTFOE RESPIRATOR** is light and compact for dependable protection against dusts, vapors, and mists. Allows maximum vision by the wearer. It's easy to clean. Design is modern and functional.



☐ **M-S-A® MINE RESCUE COMMUNICATION SYSTEM** with speaking diaphragm face piece sets up positive "party line" communication between rescue team and fresh air base. Transistorized. Battery-powered.

☐ **M-S-A® COMFO CAP WITH FIXED-CROWN* SUSPENSION** is safest on the outside, safest on the inside. New double-cradle design gives both fixed-crown clearance and easily adjustable comfort. No pressure points.

*Trademark



☑ CHECK ITEMS OF INTEREST

We will furnish further details

Check off the MSA products which you would like to know more about. Then tear out this page, send it to MSA. We will send you the additional information requested. An MSA representative will be pleased to relate the advantages of these items to your operation: in terms of full-shift protection, more tons per man. No obligation, ever.

MSA® SAFETY EQUIPMENT HEADQUARTERS

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